FOUNDRY TRADE JOURNAL
Established 1902
WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

Vol. 87 Thursday, December 29, 1949 No. 1739

49, Wellington Street, London, W.C.2
Grams: "Zacatecas, Rand, London"
'Phone: Temple Bar 3951 (Private Branch Exchange)
PUBLISHED WEEKLY: 26s. per annum (Home and Overseas)

1949 in Retrospect

The year will be going out with traditional ceremony next Saturday and reflections will turn to what has been accomplished and to the future. In the field of foreign foundry relationships, a most successful international congress was held in Amsterdam. Generous hospitality, the survey of a go-ahead industry, a wealth of technical papers combined with glorious sunshine, made this a memorable occasion for foundrymen coming from all over the world. The Netherlands can be justly proud of the real contribution they made towards promoting friendship amongst foundrymen, whilst reinforcing their knowledge.

Technical Progress

A primary object of the great technical institutes attached to the foundry industry is to mirror progress. This year, all of them have carried news of nodular or spherulitic or ductile cast irons, and many examples of the practical applications have been reported. From now on, a steady but not spectacular progress can be anticipated. Much the same can be said of precision casting.

The Institute of British Foundrymen broke away from tradition by holding its annual conference in a non-industrial centre, Cheltenham—though in 1921 Blackpool was chosen. With modern transport there were but few drawbacks, and these were outweighed by the many advantages, outstanding amongst which was the fact that everybody was away from home and remote from the office, and so enjoyed the fullest participation. Mr. Noel Newman made an excellent impression, as his imposing stature combined with a clarity of expression, well seasoned with real humour, provided the essential qualities for a popular and efficient president. A pleasing feature of these post-war conferences, be they in France or the United Kingdom, is the ever-increasing foreign participation. The British are fast learning to appreciate the Latin logic of the French, whilst the French are striving to inculcate their members as to the value to be derived from discussion such as is normal in this country. One witty French writer has commended to his readers the Institute's custom of holding meetings in June as no speaker is interrupted by fits of coughing! We congratulate the Lincoln section on being promoted to a full branch of the Institute; this is due in a major degree to the unremitting toil over many years by Dr. Walter.

Research Activities

During the year, the Southern Ironfounders' Association launched the system of the visiting of members' works by a team of knowledgeable people with the object of advising as to where improvements could be made. The chairman, Mr. Malcolm Glenny, is in possession of so many appreciative letters that it is obvious that the work has been thoroughly worthwhile. In the future, the British Cast Iron Research Association is to improve upon this activity by the creation of a team of experts and by making its services available for all ironfounders who care to make use of them. We are happy in the thought that at long last the B.C.I.R.A. no longer has its activities stultified by lack of finance; this lack had been chronic almost since its inception. Though much additional help can be confidently expected from this source, there is an increasing

(*Continued overleaf.*)

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1949 *in Retrospect*

need for the private individual to make his contribution to the technological pool of knowledge. We have noted a falling-off of such work since co-operative research has been so much to the forefront. This is to be deplored.

Iron Castings

Whilst the final production figures for the year are not yet available, it is reasonably certain that the output of grey-iron and malleable castings will attain record levels and be of the order of 3.3 million tons. The huge expenditure this section of the industry has made on plant extensions since the war has revolutionised many production methods. Yet the end is not in sight. The directors of some of the largest plants are conscious of the fact that their foundries had for many years been neglected and they have every intention of bringing them up to date and—moreover—of keeping them in that state. Very soon, a team of ironfounders is leaving for America, and in preparation for the visit the members will have made a thorough inspection of much of the home industry. This will materially help the production of a report of outstanding interest to both Americans and British.

Steel Castings

This industry has been well to the forefront during 1949, on account of the epoch-making report of the first team to visit the States under the auspices of the Anglo-American Productivity Council. Mr. F. A. Martin, O.B.E., was an ideal leader, and his appointment as chairman of a special committee to implement the Report augurs well for the future progress of this section of the industry. The creation of a director of research for the steel founders with "terms of reference" very different from established practice will be watched with interest. These terms are, roughly, "ascertain where the best practice exists and then propagate its main features wherever suitable." With the spirit of friendliness which permeates the membership of the British Steel Founders' Association, the possibilities of real progress are indeed great.

Non-ferrous Foundry Practice

Matters have not been too easy for either the makers of copper-base or light-alloy castings. The prices of their raw materials have been jumping about "like a cat on hot bricks." The Association of Bronze and Brass Founders and the Light Metal Founders' Association have done good work in quickly apprising their members of these sudden changes. Business has not been so steady as one would like. Sales especially amongst some of the smaller concerns have tended to decline, and resort has been made, *force majeure*, to the increased use of miscellaneous scrap. This mitigates against continuance of technical control, which attained quite a high level during the war. Amongst the medium and larger concerns a splendid co-operative effort has been made and a progress report has been published on the mechanical properties of copper-base alloy castings. The light-alloy founders are using the Institute of British Foundrymen to an increasing extent for the publication of their papers, and this co-operation is much appreciated.

Foundry Equipment

The foundry-equipment manufacturers and the "requisites" industry have at long last found that they have more in common than exhibition policy. Through the Foundry Equipment and Supplies Association, they have been able to ensure for themselves their quotas of steel supplies and have usefully collaborated with semi-official bodies on such matters as the reduction of noxious gases and fumes in foundries. A warning was recently given by a prominent plant manufacturer that overseas foundrymen were more enterprising in the acquisition of prototype plant than home-market buyers. Past history reveals that this has often been a British failing and we had hoped that the lesson had been learnt.

Conclusion

By and large, good progress has been made. We think there is a better understanding of the problems of the industry, and real understanding is half way to a solution. The immediate business prospects are good, but the international situation is too complicated to enable anyone to visualise trends very far ahead.

Luncheons

The President of the Institute

Mr. Noel Newman, J.P., President of the Institute of British Foundrymen, on December 21, gave a luncheon party in honour of the General Ironfounders' Productivity Team (leader, Mr. S. H. Russell) at the Amberley Inn, Gloucestershire. Other guests were Monsieur Chatelin, Mr. Daniels, Mr. H. Hewins and Mr. V. C. Faulkner.

Mr. P. L. Gould, of Gould's Foundries, Limited, East Moors, Cardiff, was host of the General Ironfounders' Productivity Team at the Grand Hotel, Bristol, on December 22.

Casting a Large Pulley in Aluminium Alloy*

Details of an out-of-the-ordinary job

By W. Wilson and A. Talbot

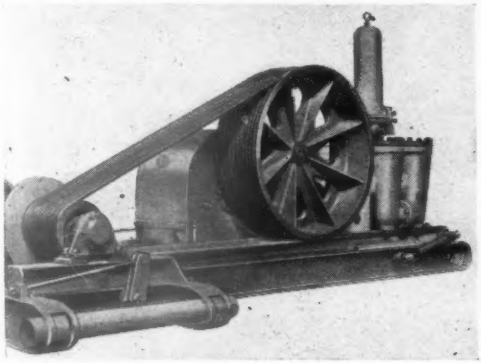
In line with the national policy of dollar saving and the expansion of the export programme, the company with which the Authors are associated had resumed the manufacture of oil-field equipment on the cessation of hostilities and were required to develop new lines in conjunction with other manufacturers to cover the demands of the oil-fields who, pre-war, had been supplied by dollar countries, to the extent of 95 per cent. of their requirements. The foundry provides the castings for this side of the organisation, as well as the diverse market for jobbing castings, from milk and bakery equipment to machine tools and electric-resistance gear. Castings are made from a fraction of an ounce to 5 tons in weight, mainly in cast iron, with a minor output of non-ferrous and light alloys.

Choice of Material

With this picture in mind, it can be seen that no special provision had to be made when the company was asked to manufacture Vee-rope pulleys in cast iron for driving slush pumps used as part of the drilling equipment in the oilfields. The complete rigs are transported from site to site and the pulleys vary in size with the pump, gear ratio, and the number of belts used, depending on the power to be transmitted. The first pulley casting, shown in Fig. 1 as part of the finished pump, weighed 34 cwt. in iron, having a pitch-centre of 55½ in. dia. and carrying 12 belts. When the question arose of making a pulley of 69½-in. pitch-centre dia. to take 20 belts, calculation showed the weight to be 7,000 lb. in iron, which gave food for thought when one remembered the working conditions and transport problems to be faced in the oilfields, not to mention machine stresses. The customer suggested aluminium, leaving the foundry to provide an alloy to suit service conditions in tropical and marine atmospheres where corrosion is severe.

Fresh designs for a box-section wheel were submitted after careful thought and study of full-size drawings, so that the moulding technique and layout

*Paper read before the London Branch of the Institute of British Foundrymen, Mr. F. Arnold Wilson presiding. The Authors are on the staff of LeGrand, Sutcliffe & Gell, Limited.



[Courtesy J. H. Fenner & Company, Limited.

FIG. 1.—CAST-IRON VEE-ROPE PULLEY AS PART OF A FINISHED SLUSH PUMP.

FIG. 2.—CONSTRUCTION OF A LAMINATED FULL BLOCK PATTERN FOR THE WHEEL.

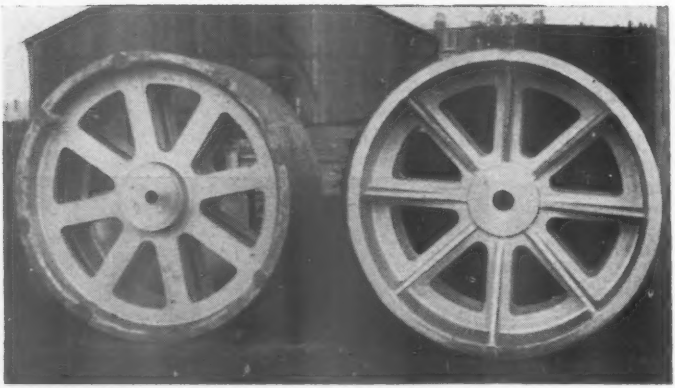


FIG. 3.—TWO FINISHED, 6-FT. DIA. ALUMINIUM PULLEY CASTINGS (FROM OPPOSITE ENDS).

could be suitably planned. The weight of the pulley in 2L33 aluminium alloy (including the steel inserts) was estimated to be 2,600 lb.; the casting would be 6 ft. dia. with a rim thickness varying from 2¾ in. to 3 in. (taper) and a face of 34½ in., allowing for a feeding head of 4½ in. on both the rim and boss (which latter, incidentally, gave the utmost satisfaction). The plates were 1¼ in. thick and the webs 1¼ in. tapering to 1½ in. at the plates; the boss was 15 in. dia. with a 5-in. dia. core 21¼ in. long. It was decided to proceed with castings to this design and Fig. 3 shows the opposite sides of two castings, the fettled weight of each being 3,600 lb.

Pattern and Core Box

It was decided to turn up a full block pattern of laminated construction with the middle or main plate built integral with the rim, as shown in Fig. 2. Starting the build-up from the bottom, the rim was turned both outside and inside up to the middle plate; from there the box section was turned on the outside only, thus limiting the weight on the face-plate of the lathe. When the rim of built-up pattern had been completed, the job was released from the lathe and the top plate of the box-section holding the boss to the rim was inserted, giving a completed pattern before painting, as shown in Fig. 4. Due to

FIG. 4.—COMPLETED PATTERN BEFORE PAINTING.

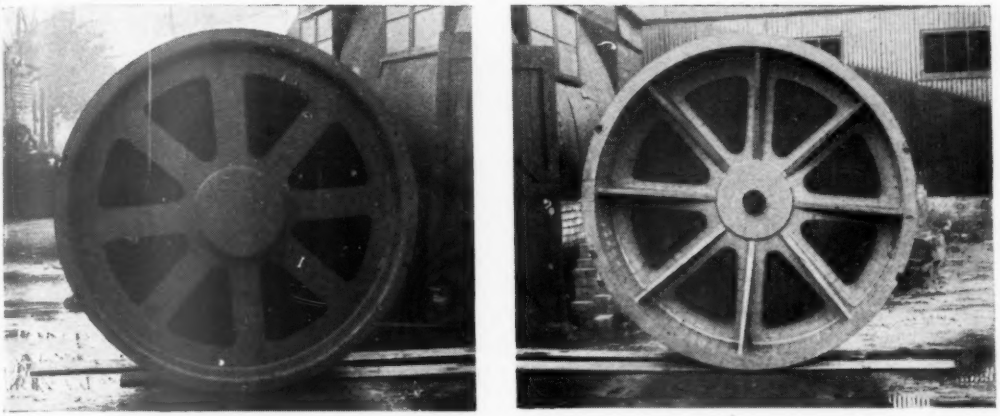


FIG. 5.—VIEWS FROM OPPOSITE SIDES OF THE FINISHED PATTERN.

the depth of the rim and the danger of disturbing some of the large number of chills which it was intended to use, any idea of rapping the pattern was out of the question, so generous tapers on the webs were allowed, together with a taper of $\frac{1}{8}$ in. on the rim from the top to bottom. The pattern was strapped with four lengths of $\frac{1}{4}$-in. flat steel, with eyes at both ends for handling, the eyes at the bottom of the straps being used to carry and lower the pattern on the box part prior to ramming up. Those at the top of the pattern were used for drawing the pattern out of the mould. Fig. 5 shows both sides of the finished pattern ready for the foundry. The main core box was a standard, enclosed, loose-segment box,

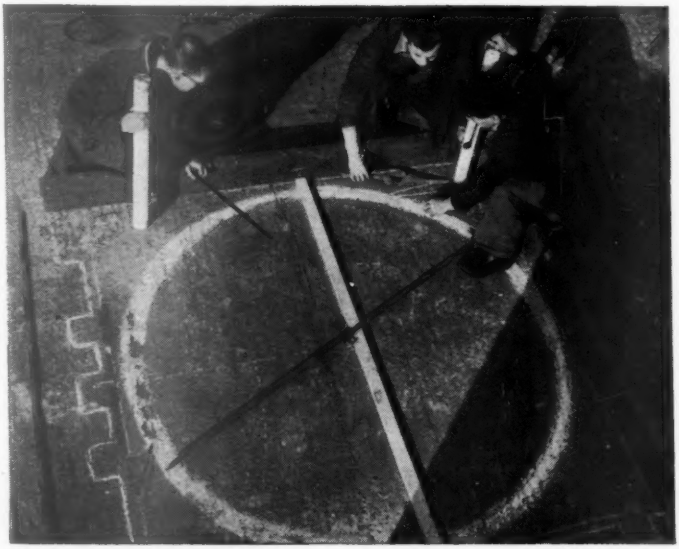


FIG. 6.—PLANNING THE MOULDING DETAILS.

FIG. 7. — SHAPED CAST-IRON SECTIONS USED TO CHILL THE ENTIRE OUTER FACE OF THE PULLEY RIM.

having top and side segments made from mahogany. The whole of the assembled box was secured by bolts and wing nuts.

Detail Procedure

Moulding presented very few problems once the preliminary details had been settled on the usual foundry "drawing board"—the nearest flat floor (Fig. 6). Chilling or densening was probably the greatest problem, as no data were available for an aluminium casting of this size and section, and the earlier largest casting had been a machine cabinet of 140 lb., with sections of $\frac{1}{4}$ in. to $\frac{5}{16}$ in. By combining common sense in considering the results of collaboration between men with theoretical and technical viewpoints on the one hand, and practical experience on the other, the Authors arrived at the procedure shortly to be described, which has been varied only slightly in the light of acquired knowledge, and has been used successfully for several castings and is now regarded as standard practice. This should not be accepted as the one and only possible tech-

FIG. 8.—STRIP CHILLS ARRANGED ROUND THE INTERIOR SEGMENTS FOR THE LOWER RIM.

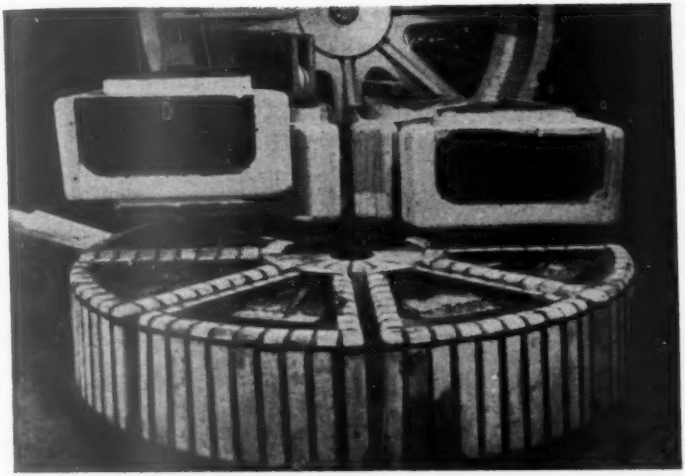


FIG. 9.—CORES TO FORM THE INTERNAL BOX-SECTION, SHOWING THE ARRANGEMENT OF CHILLS ON THE CORNERS.

nique, as other methods would probably give the required results, but it is one which conformed with local conditions.

Chilling

Shaped cast-iron sections are used to act as chills on the entire outer face of the rim, as is shown in Fig. 7. These are 14 in. by 14 in. by 1 in. thick, flanged all round and cross ribbed, with ¼-in. dia. drilled holes for venting purposes spaced at 2-in. intervals over the chill face. Strip chills, 2½ in. wide, ¾ in. thick, 14 in. long, face the mould on the inside of the rim from the main-plate to the bottom and protrude 3 in. into the drag sand for security (Fig. 8). These were originally of 87/7/3/3 gunmetal, but were later replaced by cast iron, as they were found to be unsatisfactory, due apparently to transmission of elements from the gunmetal and their replacement by aluminium. An analysis of a white deposit found subsequently inside a gunmetal chill gave approximately 23 per cent. copper with aluminium as the base constituent.

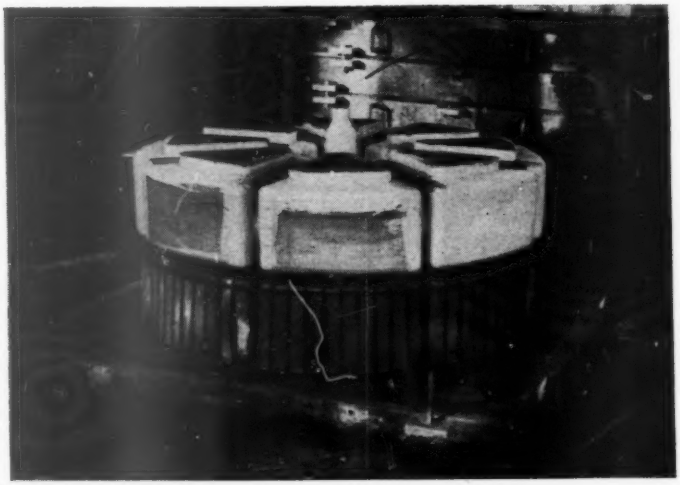


FIG. 10.—BOX-SECTION CORES PLACED IN POSITION IN THE MOULD.

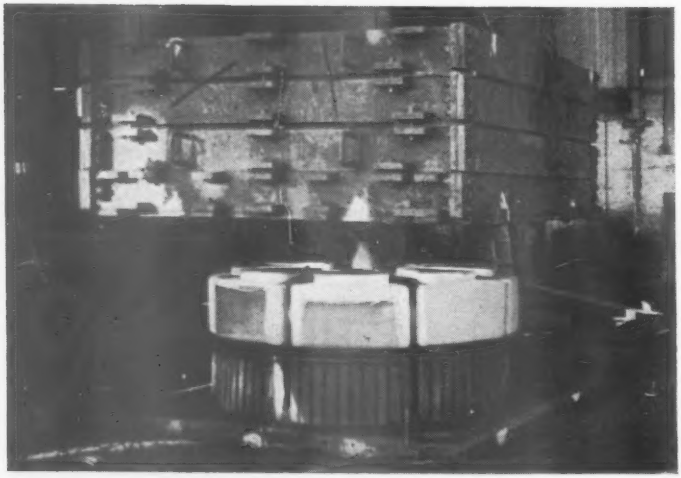


FIG. 11.—REPLACING THE MIDDLE PART MOULD ON THE DRAG AFTER ASSEMBLING THE CORES.

In the now-established practice, a row of chills is arranged to follow the line of the mainplate where it joins the webs, the rim and the boss in each section, and the bottom of the boss is chilled with tapered segments to form a complete circle. These can be seen in Fig. 7 in position in the mould. Sand gaps between all chills are standardised throughout at ¼ in. The cores forming the box section carry chills on each of the three corners (Figs. 9 and 10). All chills, with the exception of those used on the wheel face, are ⅜ in. thick, with a maximum width of 2½ in., and are dressed with china clay and plumbago painted on and stoved prior to use. The total number of chills used in the mould is 364 and in the cores, 56.

Moulding

The sand used throughout is the ironfoundry floor sand with yellow loam added for the top part. Everything is planned on three-part moulding—drag, middle and cope built up from standard 6-ft. 6-in. square box parts. A special carrying plate cast in four parts fits round the pattern and is fitted to the mid-section, allowing a clearance of ⅝ in. on the bottom diameter.

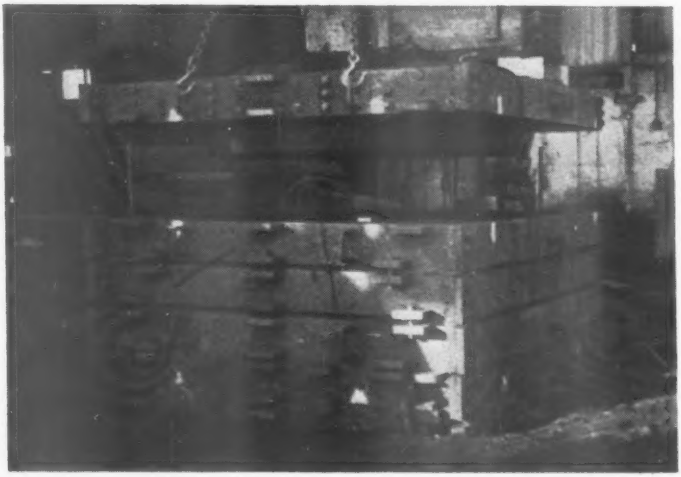


FIG. 12.—FINAL CLOSING OF THE MOULD PRIOR TO CASTING.

To enable the moulders to set the chills and ram the bottom "cod" first, the pattern is laid on the top part with the mid-part round it. After securely wedging the pattern to prevent it slipping when turning over, the bearing plate is put into position to act as a flat table or odd side from which to work. To enable the bottom "cod" to take the weight of the eight 3-cwt. cores, it is necessary to strengthen the core seatings by bringing up a solid bearing 9 in. square under each print right from the bottom grid, so that complete rigidity can be obtained. After turning over, the bottom joint is finished and the mid part, with the bearer plate secured to it, is rammed up with all the outer chills—a total weight of 25¼ cwt. These chills are also wired back as a precautionary measure, although the flanges at the top, bottom and sides should give the necessary security.

After the top has been rammed, it is lifted off and the pattern drawn. The middle and bottom are then parted, leaving the bottom "cod" free and accessible for finishing and the placing of the eight main cores with the eight window cores connecting these together (Figs. 9 and 10). This enables proper cleanliness of the mould to be assured before assembly.

All chills are sprayed with paraffin, and the gaps between the chills in the mid part and the vent holes in the same are carefully rammed, after which all chills are again paraffin-sprayed before the mid part is replaced on the assembled drag (Fig. 11). The runner basin is made up on the cope before the mould is closed for casting (Fig. 12). The mould is cast in the "green" state (with the exception of the cores) immediately upon completion. Casting is carried out from one ladle, which delivers into a runner basin incorporating a large check core, the depth of which governs the flow of metal through two 2¾-in. dia. gates into two main heads, 7 in. long, 3 in. wide and 9 in. deep, on the centre boss. These heads also serve for feeding.

FIG. 13.—MELTING FURNACE WITH COVER AND BATH REMOVED; THE LADLE PIT IS SHOWN IN THE FOREGROUND.

Coremaking

The dangers of hot-tearing and cracking have been greatly reduced, if not eliminated, by the choice of the L33 aluminium alloy for the job, so that it has been found possible to make the eight box-section cores by routine methods within the framework of the current

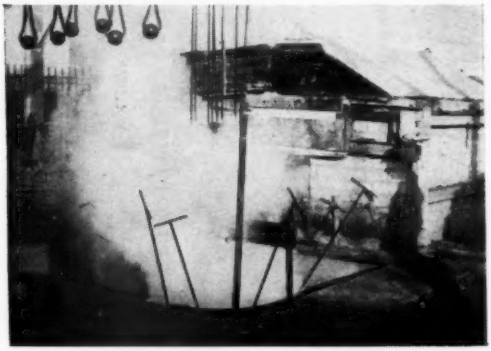


FIG. 14.—METAL TAPPED INTO A STEEL LADLE HELD FROM AN OVERHEAD CRANE, AND DE-GASSED AND "MODIFIED" BEFORE CASTING.

production schedule. Due to the weight of the core, the print section is made in a false box, using a sand of high dry-strength and incorporating a heavy, triangular cast-iron grid with wrought-iron staples (for lifting purposes). This is dried and used as the main bearing when making the core. The overhang of the core over the print is 4½ in., so a light cast-iron grid is used to carry this and the heavy corner chills. These chills are further secured by wiring them back to the main lifting staples. The sand used is of a high green-bond with less than average dry-strength and the centre of the core is filled with coke breeze to give easy collapsibility and trimming. When a casting is cold, the light grid is broken up and the main print grid is recovered. The light supplementary grids are cheaply and quickly made from a fixed template as required. The core-sand mixture consists of:—2 parts Ryarsh sand, 1 part Erith strong loam sand, and 1½ per cent. core compound. The remainder of the cores, for the windows and the centre bore, were made from the core sand in daily use.

Metal Melting

It must be remembered that as the foundry is primarily an ironfoundry and the pit furnaces have a total melting capacity of only 300 lb. aluminium, a separate melting unit had, therefore, to be constructed for this job. Despite the many flights of fancy entertained before agreement was reached on its construction, the furnace is simplicity itself and holds the 4,000-lb. melt comfortably. It is shown in Fig. 13. It was a rectangular firebrick structure, 7 ft. by 4 ft. 6 in. by 3 ft. 3 in. deep to the firebars (these are internal dimensions),

FIG. 15.—POURING THE PULLEY WHEEL CASTING. NOTE THE PREPARATIONS FOR LIFTING THE STOPPERS.

strengthened with steel channel in a frame around the outside. The cast-iron bath used to hold the metal is semi-circular in end-section, 7 ft. long, 40 in. wide and 1¼ in. thick at the sides, running to 2½ in. thick at the bottom. Six bearing lugs are cast on, three on either side, projecting 6 in. from the bath, 2 in. wide and 6 in. deep. The bath rests on pillars built integrally with the end walls and supported by the three wings or lugs on either side, resting on bricks projecting from the side walls. To retain the heat, a roof of welded-steel construction rammed with fireclay was dropped on after charging.

The furnace is coke fired by feeding fuel into the 6-in. gap on either side of the bath and a fan is available for forced draught to speed-up the melting as required. Air is delivered from the fan and controlled by a butterfly valve in the blast pipe which passes down the middle of the furnace underneath the fire bars. Equal distribution of the blast is effected by air outlets from the main in the form of four slots cut at equal intervals along either side.

The metal is run off through a tap hole 2½ in. dia. in one end and is collected in a preheated steel ladle, hanging from the crane in a pit (Fig. 13) below the level of the furnace. Plungers, bath and ladle are coated with a china-clay wash and dried prior to use. The wash is made up from china clay, 5 lb., water-glass 1 lb., with water to give a creamy consistency similar to whitewash.

Procedure Details

Using forced draught, it was found that the metal could be melted ready for tapping in periods varying from 2¼ to 2¾ hrs., but this was found to give a life of only three to four heats per bath; 14 cwt. of coke was needed. Natural-draught melting has since been resorted to, the blast being turned on intermittently to maintain an even temperature when necessary after coking-up, which happens only once in each melt after the metal has started to melt. This revised procedure lengthens the melting period to about six hours, but has more than doubled the life of the bath and reduced the coke consumption to 10 or 11 cwt.

After lighting the furnace, the complete charge of 4,000 lb. is loaded into the bath, together with 40 lb. of flux (⅞ sodium chloride, ⅛ sodium fluoride). By this time, the bed coke has ignited and is spread over the fire bars before filling the firing space with coke. The roof is then put on and forced draught is used to bring the coke to a glow, when natural draught is allowed to maintain the temperature as the heat penetrates the bath and is dissipated in the melting metal. The melting process is assisted by moving the ingots from the cold spot in the centre of the bath to the sides where heat transference is more rapid. It is found, as the pool of metal increases and floats the last of the solid charge in the cold spot. that this metal becomes welded into a solid mass which has to be broken up by poking with steel bars. To assist the breaking-up process, sawdust and flux are scattered liberally between the layers of ingots when charging. The presence of the sawdust causes the flux to glow as the temperature rises over 600 deg. C. As soon as the last ingots are melted, forced draught is used to bring the metal to 700 deg. C. when the flux is skimmed off the bath before tapping at 720 deg. C. (Fig. 14). The metal is run off into a preheated ladle where de-gasification and modification takes place. De-gasification is accomplished by immersing proprietary tabloid material with a hexachlorathine base in the proportion of 2½ oz. per 100 lb. of metal or 100 oz. total; modification is performed by adding 70 oz. metallic sodium or 1¾ oz. per 100 lb. melt (Fig.14). By the time the metal is skimmed and hoisted into pouring

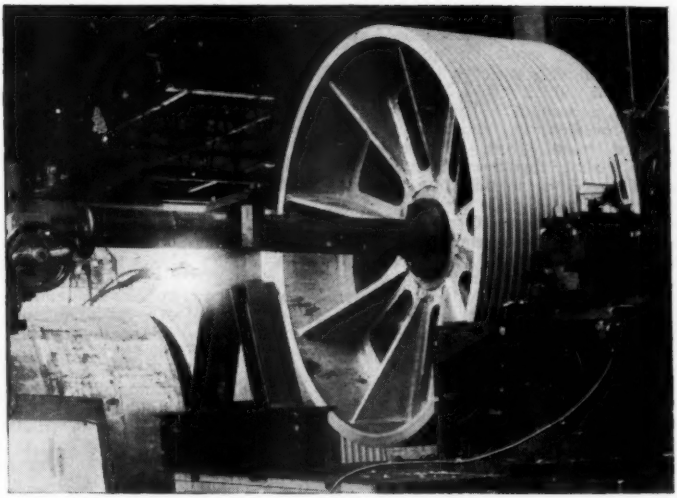


FIG. 16.—WHEEL CASTING AS SET UP FOR MACHINING THE ROPE GROOVES.

position, the temperature falls to between 630 and 640 deg. C. as 30 to 35 min. elapse from the time of tapping. The pouring of the mould (Fig. 15) takes

FIG. 17.—VIEW OF THE FINISHED MACHINED CASTING.

1½ min. and the small overmelt is run into pig form for re-melting in the pit furnaces, together with the metal skimmings, for feeding. The furnace dross, which includes the flux and residual sawdust, is exceptionally metal free but becomes incandescent after being left undisturbed for a short time.

Feeding

After casting, the runner box is removed and the surplus metal re-melted in the pit furnaces is poured into the feeding heads. It is found that, after a period of 5 to 7 min. has elapsed. 100 lb. of metal is required for topping up. The liquid shrinkage in the risers leading off the boss, which, literally, feed the webs and plates, is visible and measurable for a considerable time before the setting of metal round the sides renders rod-feeding necessary. Rod-feeding is continued until the whole mass has set; the total time for feeding is about 2¼ hrs.

Fettling

The moulding boxes are unbolted immediately after the casting has solidified, but it is not found necessary to break up mould before the following day, when the casting has receded from the rim chills by about ¼ in. The standard contraction of $\frac{3}{16}$ in. per ft. allowed on the pattern was greater than necessary as the casting finishes at 72¼ in. dia.

Knocking Out

The sand, when knocked out of the inside of the rim, brings the chills with it and, by breaking the light cast-iron core grids, the coke-filled, oil-bonded cores are easily knocked out, allowing the corner chills to be extracted. The feeding heads are nicked with a

Casting a Pulley in Aluminium

hacksaw to a depth of about 1 in. before being knocked off with a sledge hammer. When the risers are broken off, a coarse-grained structure is visible in quite a number of places in the risers, but this varies considerably, indicating the presence of unmodified metal from over-heated metal additions during feeding, together with a probable grain growth during the long solidification period caused by the heavy sections.

Normal hammer and chisel fettling removes the flash round the core prints and a coat of aluminium paint (as a ground coat for corrosion resistance) completes the founder's job. Due to the large mass of the casting it is found advisable to use manilla rope slings for handling, as the metal tends to bruise and distort when handled by chains or other means.

Machining

As machine-shop capacity for work of this size is at a premium and the sub-contractor could not comply with delivery requirements, the machine shops, like the foundry, have found it necessary to improvise. The only tool available is a horizontal boring mill which faces, bores and counter bores the boss on the casting, while it rests in a cradle on the work table. At this stage, the keyways are cut and the steel inserts are forced into place with the keyways in line, so that a splined mandrel or boring bar put through the bore of the wheel may use the keyway to drive the job as in centre-lathe practice. An additional drive is obtained by leaving out four of the set bolts used to hold the inserts in place, so that four pins fixed to the back plate may be slipped into position, when the mandrel boring bar is pushed through from the headstock of the boring machine to the steady. This means that, instead of the boring head carrying the tool, it carries the work, while the work table has a tool-box fitted (with a compound slide) to enable the tool to pick up the angle of the grooves, thus turning the machine into a sort of lathe (Fig. 16). The machinery speeds were 500 ft. per min. at 25 r.p.m., or 700 ft. per min. at 30 r.p.m.

Two more orthodox methods were used by outside contractors who helped with the machining because of the urgency of the first few wheels. The first used a vertical borer, which is, of course, the ideal method, while the other used a lathe, which, however, proved too slow.

The feeding head is cut away in layers and comes off as small chips due to the oxide inclusions, which suggests that the flowing through of metal has little or no effect. When cutting across the face of the rim and forming the grooves, the metal is free-cutting and curls off the job in long spirals. A strange feature noticed during machining at high speeds on the vertical borer was that the plates and webs appeared to be visible in shadow effect through the rim, but no evidence of colour variation or noticeable difference in grain size to account for this could be found when the wheel was stationary.

Fig. 17 shows a wheel finished ready for painting prior to despatch; it weighs 2,400 lb. or approximately one-third the weight of an iron wheel of similar dimensions. The wheels are driven at 347 r.p.m. by a 500-h.p. motor, which means a peripheral speed of 5,000 ft. per min. After a trial run of about 20 hrs. while the pump was under test, the first wheel showed no sign of polishing or abrasion in the grooves from the belts. The latter showed no aluminium pick-up, as might have been expected from such a relatively soft metal in the circumstances.

An analysis taken from the machining swarf indicated no iron pick-up and, after re-melting, the resulting ingot was found to be still within specification. This showed that the melting conditions, though crude, were at least functioning properly without being wasteful by over-oxidation and stewing of the metal.

One of the wheels was checked by means of an electrical resistivity test for porosity, with negative results. Also, at the customer's request, a selection of X-ray photographs were taken at the junctions of rim, webs and plates and the boss; as far as can be seen from these, major trouble from porosity has not been encountered.

Conclusion

The work required to prepare this Paper has been with a view to passing on to the industry any information which might be useful to others placed in a similar position, as there is no jobbing foundry which at some time or other does not undertake work outside its normal scope. That is the craftsman's lot and work to the craftsman is a joy.

The craftsman to-day, as always, has found the call of new and exacting work to be stronger than the familiar and commonplace, so that, when anything of an unusual nature crops up, the higher the skill required the more interest is shown. This is what keeps the craft alive under modern industrial conditions, where work has become a dull necessity and the industry ought to give thanks to those employers who provide work in which pride can be taken. It is from the jobbing foundry that the craftsmen of the future will come, as only there can youth find an outlet for the creative instinct. The Authors take this opportunity of thanking their company for the faith placed in the ability of their craftsmen to undertake such a venture.

Approximately half of the wheels have been delivered to meet orders for pumps as far away as Australia, Columbia and Sarawak, and it has given the founders the greatest pleasure to be able to do something a little bit out of the ordinary to uphold the prestige of British craftsmanship in markets which are relatively new.

MR. NORMAN M. HUNTER, general manager of Swan, Hunter & Wigham Richardson, Limited, shipbuilders, of Wallsend, since 1922, is retiring at the end of the year; he will be succeeded by MR. H. LITHGOW, yard manager, and MR. N. H. HUNTER, son of Mr. N. M. Hunter, has been appointed yard manager. COL. HARRY BEALE, who has held managerial positions with the company, has also retired after 62 years' service.

Ferrous Melting Furnaces in the United States and Canada*

By A. W. Gregg†

(*Concluded from page* 740.)

Steelfoundry Melting Furnaces

In the United States and Canada there are about 300 steelfoundries making commercial castings, of which 22 are so-called captive foundries. According to the Steel Founders' Society of America, the industry delivers in a normal year about 750,000 tons of castings. In the peak year of 1942, production was 1,523,015 metric tons. Railways consume 35 per cent. of the product, machinery and tools 25 per cent., rolling mills 15 per cent., and the remaining 25 per cent. is scattered among many different industries.

*American exchange Paper to the International Foundry Congress, 1949, at Amsterdam.

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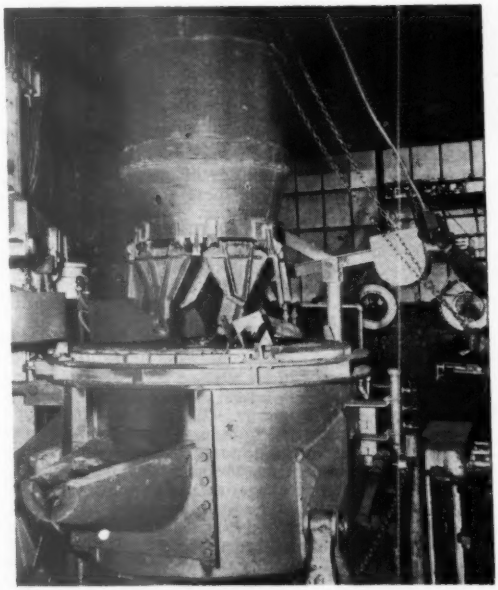

FIG. 10.—TOP-CHARGED ELECTRIC-ARC FURNACE WITH SIVYER-TYPE CHARGING BUCKET.

Upwards of 20 per cent. of the steelfoundries' output is alloy steel of various compositions.

The electric-arc furnace is the most widely used melting furnace, especially for the production of small and medium-size castings. In 1948, 43½ per cent. of total tonnage produced was made in electric furnaces. The open-hearth furnace is used for large tonnages and heavy castings. The side-blow converter is used to produce steel for light castings of thin sections. The crucible furnace was the first steel-melting unit for the production of small steel castings and had this field almost entirely to itself prior to the introduction of the side-blow or Tropenas converter which was introduced into the United States about 1890. The crucible process then began to lose favour, and to-day the tonnage of crucible steel used for castings is negligible.

All steelfoundries now have chemical laboratories, 95 per cent. have tensile-testing machines and either Rockwell or Brinell equipment for testing hardness. Some foundries have either Charpy or Izod machines for making impact tests. At least 90 per cent. of the steelfounders have sand-testing equipment.

During 1948, 200 steelfoundries used radium for detection of interior defects, in order to improve gating and risering practice to ensure soundness in the product delivered to customers. About 100 of these foundries have regular leasing contracts for a supply of radium. Twenty foundries have X-ray equipment of 200 to 440 volt capacity, and 6 have one million volt X-ray equipment. About 60 per cent. of the steelfoundries in America will accept orders for castings subject to magnetic-particle testing specifications.

The Steel Founders' Society of America has 185 member foundries and has been a most important influence in the development of the steel-casting industry in the United States and Canada. Co-operative research has developed improved methods of melting, moulding, core-making and testing. Exchange of information between members (and even competitors) has been an important influence in the growth of the steel-casting industry, and has resulted in castings of improved quality and lower production costs.

Electric Furnace

The electric-arc furnace had its first big start in the steelfoundries of America during World War I and continued to expand its field during World War II. In 1948 there were about 425 electric-arc furnaces in use in the steelfoundries of the United States and Canada. These furnaces range in holding capacity

Ferrous Melting Furnaces

from 500 lb. to 45 tons; 61 per cent. of them are less than 10 years old. The 2- to 3-ton furnace is the size in most general use in foundries specialising in small and medium-size work.

Most of the furnaces built during the last 5 years have been of the top-charge type. In fact, any other kind of charging is becoming obsolete. Top-charge furnaces (Fig. 10) reduce the time between heats to a minimum with a consequent saving in power and an increase in production. There is also a handsome saving in yard labour for making up charges, and this now is generally accomplished with a magnet yard crane. As compared with the earlier furnaces, perhaps the greatest improvement is to be found in the automatic electrode-positioning equipment, both electrical and mechanical. The newest electrical control equipment is the rotating type, which consists of a generator amplifying combination, in which rectified-electrode-arc current is balanced against rectified-arc potential, in the field of a small generator, for each phase.

If an arc current flow is too high, the generator puts out electrode motor current in one direction. If arc voltage is too high, the generator puts out electrode current in the opposite direction. The current output is always in proportion to the degree of arc off-balance for either raising or lowering the electrode.

A recently-developed automatic regulator is based on electronic control. It has no moving parts and can respond for changes in a fraction of a cycle, provided the mechanical control can handle such a fast response without overheating or hunting. This equipment is still in the experimental stage, but it may be the next important development in electric furnace control equipment.

There are two classes of mechanical electrode-positioning equipment in current use to-day:—(1) A motor-winch steel-cable drive, wherein a steel cable is directly attached to a motor-winch drum, or a steel-cable counterbalanced drive. (2) Hydraulic electrode-positioning equipment is a recent development and is extremely sensitive and accurate. The weight of the electrode arm and moving parts is counterbalanced with air pressure. By counterbalancing the weight of the electrode arm and the weight of the electrode parts with air pressure, a small reversing metering pump motor can be used to accomplish the actual fluid movement in adjusting the electrodes.

The majority of electric furnaces in steelfoundries are operated with an acid lining. This was customary before the war because in ordinary times low-phosphorus, low-sulphur scrap was in good supply. During the last war, however, some 65 foundries were obliged to change to basic practice when low-phosphorus scrap was practically unobtainable.

Power consumption is variable, depending upon refining practice and specifications for the chemical and physical properties of the steel. About 500 kilowatt hours per ton is considered good practice and is very commonly attained with acid or single-slag basic practice. Graphite electrodes are generally used and consumption varies from 8 to 10 lb. per short ton of metal melted. Tapping temperatures for foundries making light castings are usually higher than 1,650 deg. C. Where metal is poured with shank ladles, 1,704 to 1,760 deg. C. at the furnace spout is considered necessary.

Triplexing Operation

A very interesting process, developed and operated by a large steelfoundry in Michigan, is known as triplexing. The charge, consisting largely of steel scrap, is melted in a cupola. After desulphurising in the ladle with alkali slags, the metal is blown in a side-blown converter. The converter metal is deoxidised in the ladle with manganese, silicon and aluminium, and delivered continuously to an electric furnace which has a holding capacity of about 3 converter blows and is kept reasonably full.

The metal from the electric furnace is delivered to pouring ladles suspended on a monorail, and is poured into moulds on a moving conveyor. The electric furnace in this process functions as a heated distributing ladle. Metal temperature and carbon content are checked after each delivery of metal from the converter. Power consumption in the electric furnace is about 50 kilowatt hours per ton. This process has interesting possibilities for continuous high-capacity production of steel castings. It makes possible in a steelfoundry the benefits of continuous moulding and shake-out operations.

In the foundry which developed this process, 308 metric tons of molten steel have been poured into moulds in 16 hours, furnishing a supply of metal for a continuous-moulding unit where moulds were poured at the rate of five per minute.

According to the directory of the Steel Founders' Society of America, there are 121 open-hearth furnaces in 45 steelfoundries in the United States and Canada; 71 per cent. of these furnaces are over 20 years old and only 8 per cent. are under 5 years old.

Open-hearth furnaces in foundries range from 10 to 50 tons. The size in most general use has a capacity of 30 tons. Oil is the most popular fuel, with natural gas of 1,000 B.T.U. per cubic foot in use where price is favourable and supply dependable. Some furnaces are fired with a mixture of oil and gas, and a few are fired with producer gas. Open-hearth furnaces produce about 50 per cent. of the total tonnage of steel castings. The yield of castings compared to molten metal varies from 50 to 75 per cent.

The open-hearth furnace is economical only for large tonnages and heavy castings and, for best results, should be kept in continuous operation for 24 hours per day. Improvements in open-hearth operation are due principally to improved technique and better control equipment. The manufacturers of refractory materials have improved their product year by year, and this is especially true for basic refractories.

Practically all open-hearth furnaces are mechanically charged. Two kinds of floor-type charging machines are in general use. Carbometers, pyrometers, automatic reversal equipment dependent upon the temperature of the chequer-brick chambers,

fuel- and air-proportioning equipment, draught gauges, fuel meters, etc., have made the control of open-hearth quality more certain, and replaced human judgment to a great extent. In the old days, the melter's control of temperature and carbon percentage was entirely visual, and his most valuable control equipment consisted of a pair of blue glasses.

In the steelfoundries, acid and basic open-hearth furnaces are used in about equal numbers. Basic operation is predominant in the foundries specialising in railway work. In the acid furnaces, the charge consists of 15 to 20 per cent. low-phosphorus pig-iron with 80 to 85 per cent. steel scrap. The basic furnaces charge 30 to 40 per cent. pig-iron and steel scrap. Furnace operators prefer to melt down with carbon content about 40 points higher than specified for the finished steel.

Campaigns vary from 300 to 600 heats between shut-down for general rebuilding. Front and back walls have a shorter life of perhaps 150 heats, and are replaced during a week-end shut-down. Silica brick is generally used for roofs, front and back walls—even for furnaces with basic bottoms.

Bottoms are either sintered in layers, or are rammed in place. Acid furnaces use as bottom material a sand containing about 95 per cent. silica. Dead-burned magnesite and double-burned dolomite are used in basic furnaces. A proprietary composition consisting of magnesite and a binder, marketed by several refractory companies, makes very satisfactory rammed bottoms for basic furnaces.

The Side-blown Converter

The first Tropenas side-blown converter to make steel for castings was installed in a foundry in the City of Milwaukee, Wisconsin in April, 1899. The side-blown converter soon replaced the crucible furnace for the manufacture of small and medium-size steel castings, because of its lower operating costs and ability to produce steel of high temperature in large quantities. At one time there were over 50 foundries in the United States making steel castings with the side-blown converter, and from about 1900 until World War I, it was the favoured process for the production of steel for small castings.

At the present time, according to the directory of the Steel Founders' Society of America, there are 21 foundries in the United States and Canada operating 32 converters. The vessels range in size from 1 ton to 5 tons holding capacity. The size in general use has a holding capacity of 2 tons. All converters at present are operated with acid lining. The positive-impeller type of blower is used almost universally. The usual rating for a converter blower is based on 1,400 to 1,600 cub. ft. per min. per ton of holding capacity, at pressures ranging from 4 to 5 lb.

Molten metal for the converter charge is supplied by cupolas having a composition of about 3 per cent. carbon, 0.60 to 0.70 per cent. manganese, and 1.50 to 2.00 per cent. silicon. The cupola charge consists largely of steel scrap. Because the converter operates with acid lining, phosphorus and sulphur in the charge must be within the specified limits for the finished steel.

Cupola metal is desulphurised with soda ash and caustic soda. With careful practice, upward of 70 per cent. of the sulphur in the metal can be removed with certainty. Practically all converters in America have rammed monolithic linings composed of silica ganister and a binder. A few operators use silica brick. Lining life is variable depending upon the care taken in ramming and drying. Fifty to 100 blows can be made on a lining with proper practice, and some foundries have made as many as 200 blows on a lining.

To-day, the electric furnace has replaced the side-blown converter to a great extent, but several important companies have used converters for 35 years or more to make castings for machinery subject to the most severe operating conditions. The electronic flame-control equipment developed by the Jones & Laughlin Steel Corporation has greatly simplified and made more certain the accurate detetrmination of the end-point of the blow. This instrument also has reduced blowing loss by giving warning when a boil is about to occur, thus enabling the operator to reduce pressure before a violent reaction takes place, with its

FIG. 11.—2-TON SIDE-BLOWN CONVERTER IN OPERATION. ELECTRONIC FLAME-CONTROL EQUIPMENT IN THE OPERATOR'S CABIN.

Ferrous Melting Furnaces

attendant slopping and loss of metal. Fig. 11 shows a converter in operation using electronic flame-control equipment. Recently, two large steel manufacturers have become interested in the side-blown vessel, principally because nitrogen is not picked up during the blow as in bottom-blow operation. They have successfully operated with a basic lining and reduced phosphorus from about 0.300 per cent. to 0.017 per cent. The nitrogen content of the finished steel was 0.003 per cent.

The quality of converter steel has been under attack for many years, and very unfairly so, in the opinion of many important metallurgists and foundrymen. An exhaustive research project conducted at Battelle Memorial Institute by Sims and Dahle, and reported at the Convention of the American Society for Testing Materials in May, 1942, compared the physical and chemical properties of open-hearth, electric furnace, and converter steels. This investigation did much to dispel erroneous ideas concerning the quality of side-blown converter metal. All of the steels tested were of comparable analysis, were subjected to identical heat-treatments, and tests, both static and dynamic, were conducted at temperatures varying from 21 deg. C. to minus 62 deg. C. The authors found "no evidence to favour one process over the other, except that the basic open-hearth furnace gave better control of phosphorus."

The converter can make 2 to 3 blows per hour and is extremely flexible in operation. Several converter foundries have made large castings by combining several blows in a large bottom-pour ladle. The use of the converter in the triplex process has already been described under the electric furnace discussion.

High-frequency Induction Furnaces

The high-frequency electric furnace has been steadily gaining in popularity for the last 10 years, although the first production unit was not installed in the United States until 1930. It is used principally for the production of alloy steels, and especially for high-alloy steels of the corrosion and heat-resistant types.

According to the directory of the Steel Founders' Society of America, 35 foundries are now operating 88 induction furnaces, ranging in capacity from a few pounds to 2,000 lb., but the usual size in the production foundries rarely exceeds 1,000 lb. Transformers are usually rated on the basis of 800 kw. per ton of furnace holding capacity. These furnaces are lined with either acid or basic refractories. The time of melting varies with the size of the furnace, the size of the charge, and the power input.

Heats are made from clean, selected scrap containing alloys of known composition. The furnace charge must be of good density. As the change in composition is exceedingly small during the melting operation, steel can be made with accuracy to a given specification. In most operations, no slag is used. The induction furnace must be classified as a steel "melting" unit rather than "refining" unit. Numerous alloy compositions are required in the chemical and other industries, and quantities ordered may be small. The rather small capacities of the induction furnaces in operation are admirably adapted for such service. High-alloy scrap of known composition can be used in the charge without loss of alloys through oxidation.

Rocking Furnaces (Detroit Type)

Three foundries are listed in the directory of the Steel Founders' Society of America using a total of 9 rocking furnaces. These are single-phase furnaces which are usually operated in connection with other kinds of melting furnaces. Capacities and tonnage produced are small.

Malleable Iron Industry

All of the malleable iron castings made in America are of the well-known black-heart type. This type was developed by Seth Boyden at Newark, New Jersey, during the years 1826 to 1832. Boyden, whom Thomas Edison called "one of America's greatest inventors," started his experiments with the idea of duplicating the white-heart malleable iron developed by Réamur in France about 100 years earlier and commonly produced in Europe to-day.

In the early days of the industry in America, malleable iron was melted either in crucible furnaces, or in a small and very crude type of cupola. A low silicon charcoal pig-iron was charged and high-carbon white-iron produced. Small air-furnaces of 800 to 1,000 lb. holding capacity soon supplanted the cupola and the crucible furnace. Melting and annealing practices were based on rule of thumb and any improvements were regarded as trade secrets and zealously guarded as such.

To-day, under the influence of the Malleable Founders' Society, which has a membership including 70 per cent. of the industry, there is a free interchange of information, even among competitors, and all melting and annealing operations are conducted under scientific control. Four grades of black-heart malleable iron are regularly manufactured conforming to the following specifications:—

Cupola malleable iron (now used only for pipe fittings): C, 2.80 to 3.30 per cent.; Si, 1.10 to 0.60 per cent.; Mn, 0.40 to 0.65 per cent.; S, 0.25 per cent. maximum; P, 0.20 per cent. maximum; tensile strength (tons per sq. in.), 17.8 minimum; yield point (tons per sq. in.), 13.3 minimum; elongation (per cent. in 2 in.), 5 per cent. minimum.

Standard grade B, 32510, A.S.T.M. 4733: C, 2.30 to 2.70 per cent.; Si, 1.20 to 0.80 per cent.; Mn, 0.55 per cent. maximum; S, 0.18 per cent. maximum; P, 0.20 per cent. maximum; tensile strength (tons per sq. in.), 22.3 minimum; yield point (tons per sq. in.), 13.4 minimum; elongation (per cent. in 2 in.), 10 per cent. minimum.

Standard grade A, 35018, A.S.T.M. 4733: C, 2.00 to 2.50 per cent.; Si, 1.20 to 0.85 per cent.; Mn, 0.55 per cent. maximum; S, 0.18 per cent. maximum; P, 0.20 per cent. maximum; tensile strength, 23.6 mini-

FIG. 12.—12½-TON PER HOUR AIR FURNACE WITH VENTILATED BOTTOM. EMPLOYED FOR DUPLEXING IN A LARGE MALLEABLE-IRON FOUNDRY. CUPOLAS ARE IN THE BACKGROUND.

mum; yield point, 15.6 minimum; elongation (per cent. in 2 in.), 18 per cent. minimum.

Special Grades of Malleable Iron

These grades are made to meet specialised requirements. The principal compositions are those containing high silicon, copper, or copper and molybdenum. The high-silicon composition permits a very short cycle annealing period. Pearlitic structures are produced in most of the special grades. Tensile strength varies from 26.7 to 40.0 tons per sq. in. The American Society for Testing Materials has a tentative specification A 220—44T to cover these special grades of malleable iron.

In the United States and Canada, there are over 100 foundries making malleable cast iron, with production in a normal business year of 907,000 metric tons, and 50 per cent. of this tonnage is consumed by the motor-car industry. Most of the balance is used in about equal amounts by the railways and the manufacturers of agricultural machinery. The malleable foundries operate a total of about 250 air furnaces, and 50 per cent. of the foundries are making castings with metal produced by the cupola-air-furnace duplexing process.

From 60 to 70 per cent. of the total tonnage of malleable iron is now made by the duplex process and the greatest number of installations involve cupola-to-air-furnace equipment (see Fig. 12). Grade A malleable iron is readily produced by this method. At least 90 per cent. of all air furnaces are now fired with powdered coal. A few air furnaces are fired with oil and a few are still hand-fired with coal.

The two interesting tables shown below are taken from an article on duplexing practice presented by W. R. Jaeschke at the Chicago Regional Foundry Conference in 1946:—

TABLE I.—*Malleable Foundry Duplex Melting—U.S. and Canada.*

Process.	Number of installations.	Air-furnace fuel.	
		Oil.	Pul. coal.
Cupola to electric furnace	4	—	—
Cupola to air furnace	40	3	37
Cupola to open hearth	1	1	—

TABLE II.—*Malleable Duplexing Air-furnace Data—(Pulverised coal-fired.)*

Desired percentage carbon content of the iron.	Furnace hearth area in sq. ft. per ton of iron per hour.	Usual depth of iron on centre line of taphole, in in.
2.20 to 2.40	20	7
2.41 to 2.65	16	8
2.66 to 2.90	13	9

One of the foundries using the cupola-to-electric-furnace process has a rated capacity of 80 tons of melted metal per hour, and in peak periods operates 16 hours per day. This is the Saginaw Malleable Iron Division of the General Motors Company, the largest malleable ironfoundry in the world, where production of finished castings has exceeded 580 tons per 16-hr. day. With continuous operation, the cupola-electric-furnace process produces Grade B malleable iron, but if

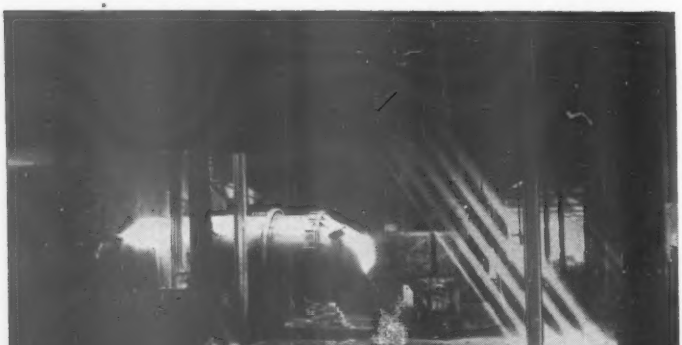

FIG. 13.—5-TON BRACKELSBERG FURNACE IN MALLEABLE-IRON FOUNDRY. DUPLEXING OPERATION WITH CUPOLA SHOWN IN BACKGROUND.

operated as a batch process can also produce Grade A malleable.

The advantages of the continuous duplexing process may be listed as follows:—

1. Because this process supplies metal continuously, it makes possible the advantages of continuous mechanised moulding and pouring practice.
2. Maximum production from a minimum of floor space and a minimum of personnel.
3. Higher efficiency in practically all foundry departments due to specialisation of pouring, shifting and shake-out operations.
4. Opportunity to improve housekeeping and working conditions, which tends to attract a better class of workmen.

Air furnaces for duplexing are built in sizes varying from about 3.5 to 20 tons per hr. The holding capacity of the air furnace used for duplexing is approximately twice the rated hourly capacity. Carbon reduction in the air furnace from that in the cupola metal varies from 20 to 50 points.

The Brackelsberg Furnace

The Brackelsberg furnace (Fig. 13) is a rotary type of air furnace which was introduced into the United States from Europe in 1930. It has a high thermal efficiency because the melting stock is heated from above by the flame and from below by contact with the heated lining. Metal-to-coal ratio is 5 or 6 to 1. Pulverised coal is generally used but some furnaces are oil-fired. High flame temperatures can be attained when the combustion air is preheated. The Brackelsberg furnace has great flexibility and can be used to produce any type of ferrous metal from steel to grey iron.

In the United States and Canada, the Brackelsberg furnace has been used principally for the production of malleable and high-strength cast iron. Holding capacities range from about 1 to 7 tons, and heats are made in 2 to 4 hours depending upon the composition and size of the charge. Silica brick is universally used for linings, and lining life varies from 100 to 150 heats.

During the war, foundry operators, in all branches of the industry, were obliged to charge melting stock which a few years earlier would have been rejected after visual inspection. By careful control and the use of alloy additions, the foundries have been successful in maintaining the quality of their various products. Ironfoundries found it necessary to improve desulphurising practice.

The use of borings in the cupola charge was made possible by the development of efficient briquetting machines, which produced easily-handled briquettes having very high density. Large hydraulic presses for making bundles from light-gauge sheet metal made satisfactory melting stock for open-hearth and electric furnaces.

The Author has endeavoured in this Paper to give, in necessarily abbreviated form, a general idea of foundry melting furnaces and their operation in the United States and Canada. There is one point he would like to stress. The present high state of development in the foundry industry is largely the result of extended research, not only by scientific and trade

(*Continued on page* 778.)

Indian Foundry Practice

Visiting Engineer's Report

Considering the difficulties under which Indian foundries are working in regard to sand and plant, many of the results achieved are highly creditable and it is doubtful whether better castings could be produced in such conditions.

This opinion is expressed by a foundry engineer who returned recently to England after spending nearly two years in India. He visited altogether some 250 foundries throughout India, mainly in Bombay, Calcutta, Patna, Kanpur, Agra, Delhi, Baroda, Indore, Tatanagar, Madras, Coimbatore, Bangalore, Harihar, Bhadravati in Mysore, Jubbalpore and Muradnagar.

The Monsoon

He was in South Africa from 1928 to 1932 and describes the Indian foundries as broadly similar to some of the smaller South African concerns of that period in regard to the method of moulding, the chief feature being that instead of using the two-part box system they bed the majority of castings in the floor. This can be a very dangerous practice, particularly during the monsoon season, due to the heavy rains which are experienced at that period, which in some localities may amount to as much as 80 to 100 inches between June and the end of September. The consequence is that moisture rises through the foundry floor and necessitates the drying of all moulds. This practice, of course, is hardly economic. The normal procedure, apparently, is to place sheet iron over the portion of the mould in the floor and light a coal fire above it. A large proportion of the heat is lost by this method, which is not only costly but unhygienic.

Many moulds are still dried by fires of dung, which is collected by the women, formed into pats, and placed on a wall to dry in the sun. This procedure seems very primitive, but it is not so very many years ago that British foundries found a use for horse manure as a sandbonding agent.

One very interesting foundry seen consisted simply of a cupola set up in an open field. The moulds were made in the field and when the foundry engineer arrived, casting was in progress and was being watched with great interest by women and children from the nearby village. This was a seasonal occupation, of course, production ceasing when the monsoon rains commenced and being restarted as soon as they were over.

Lack of Sand Control

Another failing of the majority of Indian foundries was the complete lack of sand control, particularly as regards moisture content, which often resulted during the monsoon season in from 20 to 30 per cent. of scrap. A few foundries, however, are installing sand-testing laboratories, and, once these are in full operation, the time must come when the production of castings by green-sand moulding will be a more reliable procedure.

The sands in general use in India are very open and green-strength is below normal. This problem will have to be studied and the installation of efficient sand mills will be required. At present, sand is normally mixed by hand. As every foundryman realises, this cannot give good results and the skin obtained in many of the castings leaves much to be desired. Many foundries are now installing the necessary sand-conditioning units, and moulding machines are also being introduced. It seems likely, therefore, that the quality of the castings, as well as economic factors of production, will be greatly improved.

A large number of foundry proprietors in India are fully alive to the benefits to be gained from some form of mechanisation, but at the moment a very serious difficulty seems to be presented by the lack of competent maintenance staff.

Steel Foundries

The steel foundries visited were mainly engaged in the production of railway castings such as axle boxes, buffer cases, buffer plungers, etc. Melting is usually carried out in electric furnaces and only one foundry was encountered in which molten steel was produced from a Tropenas converter. This is no doubt because of the phosphohus content of the pig-irons no hematite being available.

Cupola Practice

Great difficulty is experienced by many Indian foundries in obtaining molten iron of sufficiently high temperature, and this can be attributed to some extent to the high ash content of Indian coke, which may be anything between 20 and 30 per cent. Another reason is that many of the cupolas are only equipped with two tuyeres diametrically opposed to one another. Cupolas were seen that had been in operation for as long as twenty or even thirty years and had outlived their span of usefulness. Only by the introduction of well-designed cupolas can Indian foundries hope to obtain the high temperatures so necessary for the thin castings which they aim to produce. In the larger foundries, the melting technique leaves little to be desired, although considerable economies could be effected by the use of mechanical charging equipment.

Many non-ferrous foundries persist with the old type of coke-fired pit furnaces, but the advantages of oil-fired tilting units are being increasingly realised by the more progressive concerns. Very few foundries possess an efficient system of shot blasting and the general finish of the castings leaves much to be desired.

Casting Defects

Typical casting defects found during these visits were: Blowholes, due to high moisture content and consequent low permeability of the sands used for moulding, or to improperly-mixed core sand of low

Indian Foundry Practice

permeability and insufficiently baked; rough surface finish, due to the high-clay content of some of the facing sands and slag and sand inclusions due to faulty skimming of the metal, incorrect design of runner basin, and bad positioning of ingates.

The foundry engineer much admired the ingenuity of the Indian foundry in dealing with large castings. These are tackled by many of the smaller establishments without adequate equipment for handling the moulds. Tours undertaken in both Northern and Southern India indicated that foundry proprietors, managers and foremen were keenly aware that only by mechanical aids in the shop can India take a significant step forward towards economic industrial development. Quality control is coming increasingly into its own. Particularly impressive is the large number of young people who pass through the colleges and then take up executive positions in the foundry. These young Indians are enthusiastic and energetic. They realise that an independent India must be a productive nation if it is to hold its own in competition with other countries.

Future Policy

India's future policy will be to import only those articles which cannot be manufactured in the country. Formerly many railway castings were purchased from Britain and Sweden. The proportion of imported castings will gradually diminish, however, as existing foundries are modernised or new foundries are erected. Much British equipment is going into India and India needs the advice and co-operation of British technicians. Foundrymen in India are anxious to improve their methods and their plants and welcome the service which British experts can give. Everywhere he went this engineer met with a very friendly reception indeed and found that any advice or assistance he could give to foundries was thoroughly appreciated. He is returning to India quite soon to continue his mission of modernisation.

WORKS SCHOOLS

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—In connection with a Paper I am to present to the *Association Technique de Fonderie* on behalf of the Institute of British Foundrymen, I should like to be in possession of as much knowledge as possible of cases where foundries actually conduct classes within their works for the training of skilled craftsmen. Data concerning the number being trained, the duration of the course, and similar details would be greatly appreciated.

Yours, etc.,
V. C. FAULKNER.

49, Wellington Street,
London, W.C.2.

THE ENGINEERING REQUISITES COMPANY, of Campbell Road, Croydon, Surrey, is planning to erect a foundry at Mill Lane, Croydon.

Moulder's Appeal Fails

Judgment for Employers Upheld

In the Court of Appeal, on December 14, a West Bromwich moulder's appeal against a judgment given in favour of his employers was dismissed. Lord Justice Bucknill expressed the view that although the moulder, 64-year-old Mr. George Eden, had contracted silicosis from the sand used in his work in an ironfoundry, the appeal must fail because sand was not included in the list of siliceous materials in the Workmen's Compensation (Various Industries) (Silicosis) Scheme, 1931 to 1946. Mr. Eden was appealing against the dismissal by Judge Norris at West Bromwich County Court, of his application for compensation from his employers, Newby & Son (Iron Founders), Limited, West Bromwich, by whom he was employed from 1935 to June, 1948. On March 3, 1949, a medical board certified that by reason of silicosis accompanied by tuberculosis he had been disabled since June 2, 1948.

"There is undoubtedly a hardship on the workman in this case," said Lord Justice Bucknill, "but it is imposed entirely by the limited words of the section of the scheme dealing with the use of siliceous materials. The use of sand might well have been included. There is no doubt that this man did get silicosis from sand used in large quantities and not from the use of parting powder."

Judge Norris, in the original case, had found that the parting powder used by Mr. Eden in his work as a moulder was not a siliceous material under the scheme. He considered that the disease was due to the free silica inhaled from the moulding sand, in which case the wording of the Act did not allow compensation.

Ferrous Melting Furnaces in the U.S. and Canada

(*Continued from page* 776.)

organisations, but by the foundry operators themselves, and free exchange of information between foundrymen. Free interchange of ideas and continuous search for new facts and improved methods is the path to future advancement in this basic industry, so essential to a better and more happy world.

Acknowledgments

The Author wishes to express his appreciation and thanks for the assistance accorded him in the preparation of this Paper. This came from friends in the foundry industry, and he is especially indebted to the following:—Mr. S. C. Massari, technical director, American Foundrymen's Society; Mr. C. W. Briggs, technical director, Steel Founders' Society of America; Mr. James Lansing, technical director, Malleable Founders' Society; Mr. W. R. Jaeschke, Whiting Corporation; Mr. Antony DeYoung, Whiting Corporation; Mr. Erle Ross, Penton Publishing Company; and the technical staff of Whiting Corporation.

THE ANNUAL DINNER AND DANCE of the Lancashire branch of the Institute of British Foundrymen will be held at the Grand Hotel, Aytoun Street, Manchester, on February 3, 1950.

Example of Gating Practice for Horizontal Moulds

By "Argus"

A feature of many modern foundries where casting conveyors have been installed for the production of medium-weight iron castings in the range 2 to 15 cwts. is that the system breaks down if the moulds are required to be cast on end. In such foundries, this has the effect of bringing pressure to bear on the management to make various castings horizontally where the orthodox method would be to cast them vertically. Castings entering this category include Diesel liners of bores up to 14 in.; steam and air-compressor cylinders up to 24 in. bore, Diesel pistons, and the like.

In a great many cases, the practice of casting such work in the vertical position has been resorted to, largely with a view to the bringing of slag and any other foreign material into a position where it will do least harm, and where provision can be made to accommodate it. However, the amount of such work that can be done horizontally by the development of highly-efficient pouring and trapping systems is quite remarkable, especially if the angle of approach is that these are part of the process to be applied to all moulds almost regardless of the job that is in the mould. In the casting of any job the first hazard occurs at the pouring or head box. With the size of work under consideration, it is hardly practical or economical to use the large-capacity stoppered boxes generally applied to really large work. The most-general practice is to use a pouring box made up with green-sand, but it is highly desirable that something stronger and free from drying-out tendencies should be used at the mouth of the hole. The assembly of the two cores shown in Fig. 1 (*a*) and (*b*) is very effective. They are placed over the downgate and covered with paper, the surrounding space being made up with green-sand (*c*). This assembly provides a good means of entry for the metal to the mould, free from vortex effect and avoids the possibility of green-sand corners drying out and getting dislodged. Even if carelessly made up, the box is much less likely to be rammed-up too hard, than if the bottom were of green-sand. At the bottom of the gate is placed a syphon tap (Fig. 2), which depends on the action of centrifugal force plus syphon action as in any sanitary trap. It has been designed so that it is contained entirely in the drag half of the mould. The mass of metal in the body

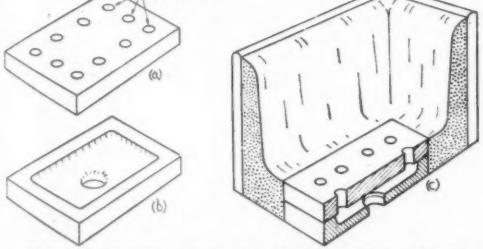

FIG. 1.—POURING BOX FOR MEDIUM-SIZE MOULD. (*a*) AND (*b*) DRY-SAND CORES; (*c*) ASSEMBLY IN A GREEN-SAND LINED BOX.

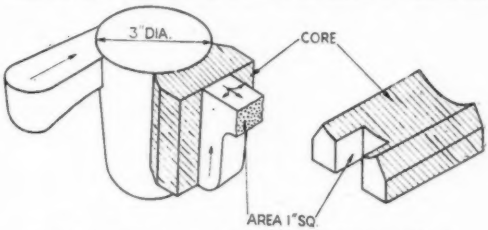

FIG. 2.—FORMER AND CORE FOR A SYPHON TRAP.

is 7 lb. or 28 cub. in. In the 4 in. between inlet and bottom outlet of the pot the over-all velocity reduction is therefore 7 to 1. The core is a slack fit so

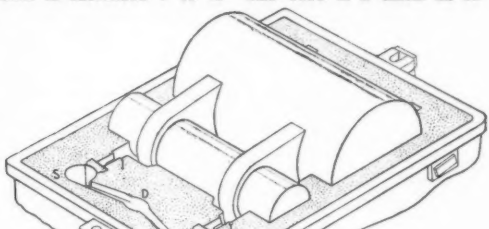

FIG. 3.—ARRANGEMENTS FOR RUNNING A MOULD FOR A STEAM CYLINDER; WEIGHT RANGE, 8 TO 12 CWT.

that it may float upwards and effectively separate from the outlet stream any slag collected at the top of the basin proper.

The syphon trap is considered quite independently from the pouring time, restrictions in the gating system coming after the trap or traps which always have a margin in their outlet area. A typical arrangement for the running of a steam cylinder in the weight range 8 to 12 cwt. is shown in Fig. 3, where D indicates the location for the downgate, S the

Gating Practice

syphon traps and I the ingates. Only two sizes of these traps are in use, one 27 cub. in. volume as sketched, and a small one exactly similar in design but with a volume of 8 cub. in. which is suitable for squeezer work. This standardisation permits the use of multiple-impression core boxes for speedy core making. The pouring-box cores are also made from multiple boxes. Both cores are suitable for core blowing. The system has been in use for two years at the Author's foundry and has given great satisfaction.

Book Reviews

The Creep of Metals and Alloys. By E. G. Stanford, M.Sc. Published by the Temple Press, Limited, Bowling Green Lane, London, E.C.1. Price 15s. net.

For some 18 years, Tapsell's well-known book has occupied a lonely position on the metallurgical bookshelf devoted to metallic creep, and one should surely refrain from grumbling if two companions—this and Dr. Sully's "Metallic Creep"*—are to be provided almost simultaneously. One may reasonably ask, however, if two are really necessary.

The text of the present work is divided into five chapters. The first deals with the technique of creep testing on the basis that creep rates require to be measured of the order of 0.1 per cent. strain per 100,000 hours. More than five pages are devoted to describing with admirable care, but unnecessary enthusiasm, the theory and practice of the Diesselhorst potentiometer, while methods of, and precautions for, satisfactory temperature control are listed with contrasting dispassion.

Chapter II is concerned with the creep curve, which is divided into four stages. The first is labelled "The First Stage of Creep," although "it does not represent deformation which takes place by the process of creep"; and the third stage is said to represent "a period in the creep history of the material when its ultimate failure may be relatively imminent." Presumably, the Author is considering the stage which is usually called "secondary creep," in which case he must be regarded as far too pessimistic to travel by "Comet."

Chapter III treats apathetically and inadequately the metallurgical factors which influence creep behaviour, providing no critical appreciation of what is known, but, instead, some unhelpful lists of things it would be very nice to know.

Chapter IV catalogues uncritically the various methods which have been suggested for presenting the results of creep tests. The fifth and final chapter provides a brief account of the progress which has been made in the physical study of the mechanism of creep. It is a much better account that one is at first led to expect by the peculiar description of "twinning" on page 83, but lacks the dilution of physical theory by metallographic evidence which would ensure its appeal to the metallurgist, to whom, nevertheless, it provides a concise statement of dislocation theory as applied to creep.

* Reviewed in the JOURNAL, September 22, 1949, p. 370.

As a companion of "Tapsell," this book may be useful to those engaged in research on creep, but the text does not present a well-balanced survey suitable for the inexperienced, to whom, however, the bibliographical appendices will be of considerable value.

H. W. G. H.

Iron and Steel. By J. H. Chesters, D.Sc. Published by Thomas Nelson & Sons, Limited, Parkside, Edinburgh, 9. Price 5s.

If a layman asks a metallurgist to tell him something of the iron and steel industry, he will usually receive a very unbalanced reply. This problem of balance has been splendidly solved by the Author, and a book has been provided from which any personnel of general school certificate standard can obtain—at low cost—a reliable and readable account of the iron and steel industry plus a modicum of foundry practice.

V. C. F.

Publications Received

Extraction and Fabrication of Aluminium. Published by the Northern Aluminium Company, Limited, Banbury, Oxford.

This delightful book contains a full history of the extraction of metal from the ore and its subsequent working up into articles of commerce, but not necessarily the final entities as received by the ultimate consumer. It contains within its 112 pages a wealth of excellent illustrations, and well maintains the high standard long established by the publicity department of this concern. A comparison between the severely technical and over-simplification for the lay reader has been achieved which makes the book really acceptable to a very wide public and thereby should promote a better understanding of its industrial potentialities.

People and Paint. Published by Imperial Chemical Industries, Limited, Paint Division, Slough, Bucks.

For our readers, the section of this booklet dealing with lawn mowers presents matter of some interest, as it seems, from a wide survey of users' opinions, that 43 per cent. complained that the painting was insufficient to prevent rusting. No fewer than 37 per cent. drew attention to chipping, scratching and the like, whilst 51 per cent. of owners had complaints as to the nature of the painting, but 85 per cent. were satisfied with green for the colour. The booklet deals similarly with gramophones, radios, vacuum cleaners, perambulators, pianos, bicycles (here 51 per cent. mentioned rusting), refrigerators and toys.

MAVOR & COULSON, LIMITED, has equipped a new works covering 64,000 sq. ft. at Farme Cross, Rutherglen, solely for the manufacture of idler rollers for conveyors. Included in the works is a modern canteen capable of seating 350 persons. When cleared for social functions there is an area of about 2,000 sq. ft. available. Throughout, great attention has been paid to heating and ventilating.

Alterations in Income Tax Assessment Procedure

By F. J. Tebbutt

In this article are given all the important alterations of recent application in income tax assessment procedure, brought about both by administrative action and by legislation up to the Finance Act, 1949, mostly applying to schedule D (business profits; persons on own account), but with references to schedule E (employments) in some instances, all being up-to-date information.

Machinery and Plant Depreciation Allowances

The ordinary "wear and tear" allowances for machinery and plant (a heading widely interpreted, including motor vehicles and fittings and fixtures), operate by yearly percentage deductions, these allowances being by agreed percentage rates for particular trades and types of machinery. This, however, is subject—for all firms—to an additional allowance, which roughly works out at one-fourth of the amount allowed to the particular firm.

By the Income Tax Act, 1945, there was introduced a new allowance called the "initial allowance," which applies where fresh machinery or plant (whether new or second-hand) is installed. Up to the Finance Act, 1949, this "initial allowance" has been 20 per cent. of the capital expenditure; now, by the Finance Act, 1949, this is to be 40 per cent. for any expenditure incurred after April 5, 1949. A "balancing allowance" also applies where fresh machinery, etc., is installed before the capital expenditure on the old has been deducted by the other allowances.

Contrasts and Differences

An "initial allowance" also applies, in respect of industrial buildings, this being 10 per cent. for new buildings, plus an annual allowance of 2 per cent. per annum, which applies both to new buildings and under-50-year-old buildings, up to a life of 50 years. profits-tax payments are deductible for income tax; income-tax payments not for profits tax. Interest may be charged if tax payments are three months overdue; interest received on Treasury Tax Certificates taken out in advance of tax payments is not assessable to tax.

Expenses incurred in obtaining a patent or registering a design or trade mark are allowable deductions. Expenditure in purchasing patent rights, although it is capital expenditure, is not now outside tax law, as now deductions from profits are allowable, but spread over a period (ordinarily 17 yrs.); the vendor pays tax on the amount received, but this also can be spread over a period (six years in this case) if it is so preferred. Income from patent rights is termed "earned income" and so attracts the earned-income allowance.

Salaries, wages, expenses, etc., paid to employees are, of course, trading expenses and allowable in respect of employers' assessments. But for directors (and employees with emoluments of £2,000 a year or more) if the remuneration is plus a lump sum for expenses, that sum must be returned for the recipient's assessments under schedule E. Ordinary expenses incurred in doing the job will, however, be allowed before tax is assessed.

Unemployment, sickness, and maternity benefits received are not now taxable (Finance Act, 1949), but, on the other hand, the part of the National Insurance contribution attributed to those benefits is not now deductible from tax; thus, for men employees as an example, 3s. is now allowed, not the full 4s. 7d., and for other classes similar procedure will apply. Ordinarily, charitable donations are not allowable as trading expenses, except where these are for the welfare of the employees. Similarly, contributions to trade charities and to employers' associations, if for the furtherance of the particular trade, are deductible; also, if relating to the particular trade of the taxpayer, contributions, even of a capital nature, made to universities, colleges, and the like, in respect of technical education are allowable deductions from profits for tax purposes.

Research Expenses

In connection with scientific research, expenditure on such items as salaries or fees of workers, for materials, repairs and maintenance, and so on, is allowable as a trading expense. Capital expenditure on such things as pilot plants and laboratories is also allowable, but the deductions operate by instalment allowances spread over five years; by the Finance Act, 1949, expenditure incurred after April 5, 1949, is to be deductible at the rate of 60 per cent. for the first year, with 10 per cent. for each of the succeeding four years of the five.

Life Assurance Allowance

The life assurance allowance is now 40 per cent. of the standard rate of tax, operating roughly against the premium(s), irrespective of total income. If the total premiums are under £25, relief is at the standard rate on £10 or on the actual amount of the premiums if it is less than this amount.

New Raw Materials Guide

Details of nearly 400 imported raw materials are contained in a new edition of "Raw Materials Guide" recently published by H.M. Stationery Office for the Board of Trade. This 75-page guide (price 1s. 6d.) lists the main uses for each raw material, together with the chief sources of supply for the United Kingdom, and gives information about import and export licences, and other Government controls.

Pig-iron and Steel Production in Great Britain

Summary of October Statistics

The following particulars of pig-iron and steel production in Great Britain have been extracted from the Statistical Bulletin for November, 1949, issued by the British Iron and Steel Federation. Table I gives the production of pig-iron and ferro-alloys in October, with the number of furnaces in blast; Table II, production of steel ingots and castings in October, and Table III, deliveries of finished steel. Table IV summarises steel-industry activities during the six months ended October.

TABLE I.—*Weekly Average Production of Pig-iron and Ferro-alloys during October, 1949. (Thousands of Tons.)*

District.	Furnaces in blast, 29.10.49.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derbyshire, Leics., Notts., Northants, and Essex	25	—	12.2	25.4	1.6	—	39.2
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (incl. Sheffield, excl. N.E. Coast)	6	—	6.8	—	—	1.3	8.1
Lincolnshire	15	—	24.6	—	—	—	24.6
North-East Coast	23	7.8	37.3	0.4	—	1.4	46.9
Scotland	9	0.8	11.6	3.1	—	—	15.5
Staffs., Shrops., Worcs., and Warwick	9	—	9.1	1.4	—	—	10.5
S. Wales and Monmouthshire	5	4.2	18.8	—	—	—	23.0
North-West Coast	7	15.9	—	0.2	—	—	16.1
Total	102	28.7	120.4	30.5	1.6	2.7	183.9
September, 1949	100	28.6	122.4	29.8	1.7	2.8	185.3
October, 1948	105	25.9	124.3	27.5	1.9	3.6	183.2

TABLE III.—*Weekly Average Deliveries of Non-alloy and Alloy Finished Steel. (Thousands of Tons.)*

Product.	1947 (53 weeks).	1948.	1948.	1949.	
			Oct.	Sept.	Oct.
Non-alloy Steel:—					
Heavy rails and sleepers	7.6	8.9	9.2	11.1	9.1
Heavy and medium plates	31.6	36.2	36.9	41.1	42.3
Other heavy products	31.8	34.7	35.6	36.4	38.2
Light rolled products§	52.9	59.5	64.1	48.7	49.0
Hot-rolled strip				18.0	18.4
Cold-rolled strip	4.6	4.7	5.0	5.0	5.1
Bright steel bars	4.8	6.0	6.1	5.7	5.8
Sheets, coated and uncoated	24.3	26.3	27.4	28.6	28.4
Tin, terne and blackplate	12.1	13.5	12.8	14.5	14.0
Tubes, pipes and fittings	13.5	15.1	15.6	19.8	21.1
Wire	10.8	12.8	14.4	16.2	15.8
Tyres, wheels and axles	3.5	3.9	4.4	3.9	4.8
Forgings	5.0	6.0	6.7	6.6	6.6
Castings	3.0	3.5	3.8	3.0	3.9
Total	205.5	231.1	242.0	258.6	262.5
Alloy Steel:—					
Tubes and pipes	0.3	0.4	0.3	0.5	0.5
Bars, sheets, strip and wire	3.7	4.7	5.2	4.2	4.7
Forgings	1.8	2.5	3.0	2.7	2.9
Castings	0.6	0.7	0.7	0.7	0.9
Total	6.4	8.3	9.2	8.1	9.0
Total U.K. production‡	211.9	239.4	251.2	266.7	271.5
Less intra-industry conversion	19.2	29.0	33.3	36.1	35.6
Net U.K. deliveries	192.7	210.4	217.9	230.6	235.9
Add imported finished steel	2.2	3.4	5.5	8.5	5.8
Total deliveries of finished steel	194.9	213.8	223.4	239.1	241.7

† Excludes high-speed steel. ‡ Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
§ Excl. wire rods and alloy-steel bars, but incl. ferro-concrete bars.

TABLE II.—*Weekly Average Production of Steel Ingots and Castings, October, 1949. (Thousands of Tons.)*

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants and Essex	—	—	9.2(Basic)	1.3	0.2	10.1	0.6	10.7
Lancs. (excl. N.W. Coast), Denbigh, Flints. and Cheshire; Yorkshire (excl. N.E. Coast and Sheffield)	1.4	22.7	—	1.1	0.4	24.6	1.0	25.6
Lincolnshire	—	30.4	—	—	0.1	30.4	0.1	30.5
North-East Coast	1.8	59.0	—	0.8	0.5	60.5	1.6	62.1
Scotland	4.2	39.9	—	1.6	0.8	44.7	1.8	46.5
Staffs., Shrops., Worcs. and Warwick	—	15.1	—	0.8	0.4	15.2	1.1	16.3
S. Wales and Monmouthshire	9.6	47.7	5.3(Basic)	0.8	0.2	63.2	0.4	63.6
Sheffield (incl. small quantity in Manchester)	8.9	25.2	—	7.9	0.7	40.7	2.0	42.7
North-West Coast	0.6	3.2	4.9 (Acid)	0.1	0.1	8.7	0.2	8.9
Total	26.5	243.2	19.4	14.4	3.4	298.1	8.8	306.9
September, 1949	27.6	239.9	20.4	14.6	3.4	297.3	8.6	305.9
October, 1948	28.9	231.0	19.4	14.3	3.6	288.4	8.8	297.2

Second Training Course for Foremen

In view of the conspicuous success which attended the foundry foremen's training course held at Ashorne Hill, last April, the Council of the Institute of British Foundrymen has decided to organise a second course which will be held from Thursday, March 23, to Saturday, March 25, 1950; Ashorne Hill will again be the venue. The programme of the new course, which is designed to give practical guidance to foremen in charge of men in the special administrative problems arising in the discharge of their duties, is as follows:—

Programme

Thursday Evening, March 23.—Assembly of those participating (4 p.m. onwards); film display and lecture on "Organisation of a Foundry and the Plant and Methods used for the Production of Castings for Internal Combustion Engines," followed by a lecture on "Jig Mounting of Patterns for Machine Moulding" (8.30 p.m.).

Friday, March 24.—In the morning there will be lectures on "Human Relations" and "Incentive Systems —Standards of Work Performance." In the afternoon a lecture on "Overheads and Production Costs," and during the evening there are to be discussion groups.

Saturday, March 25.—The morning is to be devoted to a lecture on "Production Control," and the afternoon to one on "The Maintenance of Plant and Equipment."

The subjects selected are mainly those which formed the basis of the first course, but, with the object of providing a fresh viewpoint on the problems involved, the Council has arranged for new authors to give a number of the lectures. Alternatively, for those lectures for which new authors are not available, the original lecturers have been asked to deal with their subjects from some new aspect. An innovation, intended to increase the benefits derived by those attending the course, will be the arrangement of groups to discuss the lectures.

While priority of place will be given to the foremen who applied to attend the first course, but could not be accommodated, and to those firms, who, though wishing to send many of their staff, could release only a portion for the previous occasion, it is emphasised that those who attended the first lectures will find the new course complementary in character. Within the limits of the accommodation available, therefore, those who attended the previous lectures will again be welcome.

The charge for accommodation at Ashorne Hill is 30s. per day, which includes dinner, bed, breakfast, lunch, tea, and a snack. Those attending the course who do not require sleeping accommodation at Ashorne Hill may obtain meals at a charge of 10s. per day. Ten per cent. is added to bills to cover gratuities. Participants will be free to return home on Saturday evening or to remain until Sunday or Monday if they so wish. Forms of application to attend the course may be obtained from the secretary of the Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, 3, to whom they should be returned not later than February 25, 1950.

Forthcoming Events

JANUARY 2.

Institution of Production Engineers.

Yorkshire Section:—"Modern Measuring and Inspection Equipment and its Application," by E. Clarke, at the Hotel Metropole, King Street, Leeds, 1, at 7 p.m.

JANUARY 4.

Nottingham Section:—"Noise and Vibration in Machinery," by W. A. Tuplin, D.Sc., M.I.Mech.E., at the Victoria Station Hotel, Milton Street, Nottingham, at 7 p.m.

JANUARY 5.

Glasgow Section:—Discussion on "Metal Cutting," at the Institution of Engineers and Shipbuilders, 39, Elmbank Crescent, Glasgow, C.2, at 8 p.m.

Institute of Metals.

London Local Section:—"Zinc Casting Alloys: their Development and Use," by L. A. J. Lodder, B.Sc., A.R.C.S., at 4, Grosvenor Gardens, London, S.W.1, at 7 pm.

JANUARY 6.

Institution of Mechanical Engineers

"The Lost-wax Process of Precision Casting," by J. S. Turnbull, at Storey's Gate, St. James's Park, London, S.W.1, at 5.30 p.m.

JANUARY 7.

Institute of British Foundrymen.

West Riding of Yorkshire Branch:—"High Productivity and the U.S. Steel Foundries," by F. A. Martin, O.B.E., at the Technical College, Bradford, at 6.30 p.m.

PIG-IRON AND STEEL PRODUCTION IN GREAT BRITAIN (*Continued from previous page*).

TABLE IV.—*General Summary of Pig-iron and Steel Production.* (*Weekly Average in Thousands of Tons.*)

Period.	Iron-ore output.	Imported ore consumed.	Coke receipts by blast-furnace owners.	Output of pig-iron and ferro-alloys.	Scrap. used in steel-making.	Steel (incl. alloy).			
						Imports.†	Output of ingots and castings.	Deliveries of finished steel.	Stocks.‡
1938	228	89	—	130	118	16	200	—	—
1947 (53 weeks)	209	136	165	147	145	8	240	195	797
1948	252	172	200	178	174	8	286	214	1,028
1949—May	263	171	201	187	199	22	316	245	1,121
June*	268	168	202	186	188	28	301	236	1,177
July	258	164	194	177	152	21	244	198	1,238
August*	248	172	196	182	179	21	288	205	1,320
September ..	266	177	199	185	194	19	306	239	1,331§
October	237	178	196	184	194	12	307	242	1,297*p*

* Five weeks. † Weekly average of calendar month. ‡ Stocks at end of years and months shown. § Revised. *p* Provisional.

Personal

LORD EDNAM, who has been chosen as prospective Conservative candidate for West Bromwich, is a director of the Round Oak Steel Works, Limited, Brierley Hill, Staffs.

MR. A. H. TURNER, executive director of British Iron & Steel Corporation (Salvage), Limited, has retired from that position. Since 1940, when he joined the Corporation, Mr. Turner has helped to organise the breaking-up of well over 1,000 ships.

MR. ARTHUR CROSS, present chairman and former president of the Dominion Steel & Coal Corporation, Limited, Sydney, N.S., is to retire from office on January 1, but will continue as a director; he will be succeeded as chairman by MR. C. B. LANG, who is to retire from the presidency of the company. MR. L. A. FORSYTH, executive vice-president, is appointed president.

MR. C. TUSON, a director of Keith Blackman, Limited, mechanical and electrical engineers, etc., of Tottenham, London, N.17, is retiring at the end of the year owing to ill health. He joined the company in 1897 and was elected to the board in 1921. The vacancies in the directorate caused by Mr. Tuson's retirement and the recent death of Mr. C. J. A. Galloway are being filled, respectively, by the election of MR. G. S. TEGGIN, chief of the company's contracts department, and MR. W. G. CALDER, manager of the Arbroath works. The new appointments will take effect from January 1.

MR. C. S. GILL, managing director of Davy & United Roll Foundry, Limited, Haverton Hill, Billingham, Co. Durham, has been re-elected chairman of the Roll Makers' Association of Great Britain for the fourth successive year. Mr. Gill has also been re-elected chairman of the Back-up Roll Makers' Association, a position which he has held since the Association's inception in 1947. In addition, he has been re-elected chairman of the North East Coast Association of Steelfounders and employer representative on the Tees-side District Advisory Committee of the Northern Regional Board for Industry. Mr. Gill is chairman of the Steel Roll Makers' Joint Council.

THE UNITED STEEL COMPANIES, LIMITED, have announced the following appointments, to date from January 1:—MR. GERALD STEEL, at present joint managing director, to be managing director on the chairman, Sir Walter Benton Jones, relinquishing the office of joint managing director; MR. A. J. PEECH, at present assistant managing director, to be deputy managing director; MR. K. G. LAMPSON, at present general sales manager, to be a director in charge of sales; MR. H. M. HENDERSON, at present commercial manager of Appleby-Frodingham Steel Company, to be general sales manager of the United Steel Companies, Limited, and MR. C. E. EDWARDS to be commercial manager of Appleby-Frodingham Steel Company.

MR. CECIL HIPWELL, a director and general manager of Redpath, Brown & Company, Limited, one of the structural engineering subsidiaries of Dorman, Long & Company, Limited, has been appointed a special director of Dorman, Long. He was associated for 30 years with Dorman, Long & Company's bridge and constructional departments before being appointed general manager of Redpath, Brown & Company in 1945. Mr. Hipwell was erection superintendent during the building of the Sydney Harbour bridge and later became manager of the London constructional works of Dorman, Long & Company. During the war he played a prominent part in the Mulberry invasion harbour project and in the "Shark" project which had as its purpose the rapid temporary rehabilitation of the main ports on the Continent.

Iron and Steel Prices

Changes under New Order

Several changes in prices, most of them due to increases or decreases in non-ferrous metals or in alloy materials, are effected in the Control of Iron and Steel (No. 76) Order, 1949, which came into operation on December 16. Nickel-chrome-molybdenum billets for re-rolling are increased from £44 10s. 9d. to £45 18s. 9d. and nickel-chrome-molybdenum bars, 1-in. dia. and up, from £57 18s. 9d. to £59 9s. 6d. The basis price for cold-rolled hoop and strip is increased from £31 15s. 6d. to £33.

There have been many changes in recent months in the price of galvanised products, due to fluctuations in the quotations for zinc. The No. 76 Order raises the basis price of galvanised sheets from £36 19s. 6d. to £37 6s. 6d. Galvanised corrugated sheets, 24 gauge, are now quoted at £38 6s. 6d.

Due to the decline in tin prices, tinplate has been reduced from £2 2s. 10d. per basis box to £2 1s. 9d., while terneplate has been reduced from £2 0s. 5d. to £1 19s. 7d. per basis box.

The new Order at the same time releases from price control angle cast pipes for gas and water purposes, Cellactite sheets, and Robertsons sheets.

Obituary

MR. R. C. MCDONALD, secretary-treasurer of the Dominion Steel & Coal Corporation, Limited, Sydney, N.S., has died suddenly. He was 50.

MR. FRANK WALLER, managing director of Peacock & Waller, Limited, mechanical engineers, of Hinckley, Leics, died on December 15, at the age of 64.

MR. JOSEPH HENNESSEY, who has died at the age of 74, had more than 50 years' service with Kitson & Company, Limited, engineers and ironfounders, of Leeds.

THE DEATH is announced of Mr. Victor H. Coates, M.I.M.E., in his 84th year. Mr. Coates, who had been in failing health for some time, was for many years manager of the family business, Lagan Foundry, Ravenhill Road, Belfast. During the 1914-18 war he was a government inspector of factories.

Reduced Nickel Consumption

Prospects for 1950

In a review of the nickel industry, Mr. Robert C. Stanley, chairman of the International Nickel Company of Canada, Limited, says that total world consumption of Canadian nickel in all forms for the year 1949 is expected to be about 15 per cent. lower than in 1948, when a new high peacetime record was established. During the early part of the year, he says, nickel sales remained high and were comparable to the volumes achieved in the previous year. A sharp drop in the period May through August, however, was followed by improvement during the remainder of the year to date, despite the fact that consumption was adversely affected in the autumn months by the American steel and coal strikes.

The fall in demand for nickel necessitated the company reducing nickel production in the last half of the year to a rate approximately 15 per cent. below the previous level.

Mr. Stanley says that French nickel production, which chiefly comes from New Caledonia, increased over the preceding year, but was still small compared with Canadian output. Cuban mines remained closed. Russia continued to produce nickel, but, as in past years, no information on output was made available.

This year the United States was again the largest consumer of Canadian nickel, with approximately 65 per cent. of the total, and U.K. consumption was about 20 per cent., these two countries with Canada accounting for approximately 88 per cent. of consumption.

The International Nickel Company continued its extensive plant programme designed to improve production methods, to reduce costs, and to make use of the great reserves of low-grade ore which had previously been deemed unprofitable.

Because of the broad diversification of uses of nickel and nickel alloys, Mr. Stanley expects that consumption will be well maintained during 1950.

House Organ

Malleable Iron Facts (No. 35). This is the Bulletin of the Malleable Founders' Society, Union Commerce Building, Cleveland, Ohio. The particular "kick" in this issue is a couple of pictures of a plough swivel, one—really ugly—made a four-piece welding, and a second, beautifully streamlined, made as a malleable casting. Next a comparison is made between a hydraulic press valve as machined from forged steel and made as a malleable casting. The change saved 25 per cent. in weight and 80 per cent. in machining costs. There is an announcement that the Society has sponsored a film in Technicolor, "This Moving World."

THE TELEPHONE NUMBER of the British Aluminium Company, Limited, Salisbury House, London, E.C.2, from January 1, will be Monarch 4422.

United Kingdom Tariff

Changed Rates for 1950

Changes in the United Kingdom Tariff—resulting mainly from the tariff agreements reached at Annecy—are to be introduced on January 1.

Among the items on which rates of duty are to be altered are the following, the new rates being followed by the current rates in parentheses:—

Iron and steel (including alloy steel) of the following descriptions :—

Bars and rods of all kinds (other than bars and rods of wrought iron produced by puddling with charcoal from pig-iron smelted wholly with charcoal) if the value exceeds £33 per ton, but does not exceed £70 per ton, 20 per cent. (25 per cent).

Tubes and pipes of all kinds other than cast tubes and pipes, 15 per cent. (20 per cent.).

Heat-resisting wire, rod and strip, being single-strand wire, rod of a diameter not exceeding 1 in. and strip of thickness not exceeding ½ in., not plated, coated or covered, or metal alloy containing, by weight, the following :—Chromium (19.5% to 26%), aluminium (3.5% to 6.5%), cobalt (1.5% to 4%), and not more than a total of 3 per cent., by weight, of substances other than chromium, aluminium, cobalt, and iron, 20 per cent. (strip, 20 per cent.; rod, 25 per cent.; wire, 33⅓ per cent.).

Sand-blast nozzles lined with material wholly or mainly of silicon carbide or tungsten carbide, 15 per cent. (20 per cent).

Internal combustion engines, not being stationary engines or engines of a type suitable for use in motor vehicles or aircraft, 17½ per cent. (20 per cent.).

Roller bearings and parts thereof, 20 per cent. (33⅓ per cent.).

Machinery belting (including conveyor and elevator bands) of cold-rolled strip, exceeding 10 in. in width, imported in coils; (*a*) of stainless steel, or (*b*) hardened and tempered, of charcoal steel, 10 per cent. (15 per cent.).

Aluminium, unwrought, in blocks, billets, ingots, slabs, notch bars, wire bars, sticks, and granules, but not including alloys of aluminium, free (10 per cent.).

Felspar, ground, 5 per cent. (10 per cent.).

Students' Vacation Work Scheme

The Governors of the Imperial College of Science and Technology (Royal College of Science, Royal School of Mines and City and Guilds College) have received a report from the Students' Union on the above subject. About 130 students worked overseas during their summer vacation, and a roughly corresponding number was received. By working at home and abroad, the students earned over £24,000. Many British foundry concerns participate in the scheme, details of which are available from Mr. J. Newby, Imperial College, Prince Consort Road, South Kensington, London, S.W.7.

A New Suit

Since the JOURNAL was founded in 1902, it has altered its size six times, and now it is to change once more with next week's issue. We apologise to those who have had special bookshelves made—as has happened on earlier occasions—and now find them to be a misfit. Each time there has been a good reason for the change, and the newest alteration is but an addition of about one inch to the length, yielding 16 per cent. additional type space. It will mark the end of the rather squat format used during and since the war.

Raw Material Markets

Iron and Steel

Few, if any, difficulties are being encountered by foundries in securing the required quantities of pig-iron and hematite. The low- and medium-phosphorus grades continue to be available in sufficient quantities to satisfy the demands of the engineering foundries, which are also able to obtain the hematite required in quantity, if not in the desired analyses. The major output of these grades is absorbed in current production and there is no appreciable balance for stock. Refined iron is obtainable in the required tonnages and parcels continue to be sent abroad.

The light-castings trade is not heavily committed, particularly firms producing castings for the building trades. Orders coming to hand are needed to maintain current production and, consequently, forward commitments are not increasing. Ample supplies of high-phosphorus iron are available and most foundries have a working stock. Generally, however, this is not large and the furnaces are usually able to dispose of current production.

Supplies of foundry coke are satisfactory and ganister, limestone, and firebricks can be obtained to requirements. Ferro-alloys are also available in the desired quantities and grades. Sufficient supplies of cupola scrap, both cast iron and steel, are coming forward to fulfil immediate needs. Most foundries have improved their stocks, but there is still a good demand for these grades.

There continues to be a good demand for the smallest sizes of sections, bars, and narrow strip from the light re-rollers, but there is no improvement in the call for the heavier sizes rolled by them or for the products of the heavy re-rollers. Increased demands for these sizes can only be expected when present stocks have been liquidated. Home requirements and export commitments are ensuring fairly reasonable outputs from the mills, but much more could be undertaken. Sheetmakers are inundated with orders for both black and galvanised sheets, and their outputs are fully covered for some time ahead.

Supplies of steel semis are satisfactory and the mills have no anxieties in this direction. Deliveries from home works are steady, but there is little pressure for supplies, apart from small square and flat billets, sheet bars, and special quality steels. Deliveries continue to be received from the Continent and present stocks are sufficient to meet any demands which may arise for some time ahead. Steelworks are finding it difficult to dispose of available supplies of defective material in the form of sheet bars, billets, slabs, etc., which are considered too high in price to be economical.

Non-ferrous Metals

Considering the proximity of the Christmas holiday, business last week was quite brisk, buyers perhaps being encouraged by the firm tone of the American markets. Metals, on the whole, presented a firm front, although copper scrap was slightly easier at 15 to 15¼ cents per lb. Buying of copper, now almost entirely for next month's delivery, is well maintained and it looks as if, not only December, but also January will be a period of very good deliveries.

In London the tin market is much steadier than it was and last week saw a further contraction in the backwardation which on Friday stood at £23 10s. a drop of almost £9 in a week. This is a decided improvement on the state of affairs when the market opened on November 15. At that time, it will be remembered, the premium on cash tin was as much at £80 per ton.

Metal Exchange tin quotations were as follow:—

Cash—Wednesday, £604 10s. to £605; Thursday, £604 to £605; Friday, £605 to £606; Wednesday, £602 10s. to £603 10s.

Three Months—Wednesday, £572 10s. to £573; Thursday, £575 10s. to £576 10s.; Friday, £582 5s. to £582 10s.; Wednesday, £581 to £581 10s.

The scrap market was fairly quiet before the holidays, but that was to be expected. It would appear that Ministry of Supply tenders for scrap material have been rather fewer in number this month, but that does not necessarily imply that there is less scrap to be sold from the surplus disposals stocks of old metals. So far as is known these still stand at a high level and a steady flow of material can be expected during the coming year. Margins between scrap prices and new metal values have narrowed, but are still ample enough to make a purchase of secondary metal well worthwhile. Last week, new H.C. copper scrap was offered at £140, but no business was reported.

U.S. Steel Prices Increased

Other big producers have followed the example of the United States Steel Corporation, which, recently, announced price increases averaging about 4 per cent. for most of its products.

Mr. Benjamin F. Fairless, president of the Corporation, said the price revisions "reflect actual and approaching changes in the cost of production . . . including the substantially higher cost to result when our new insurance and pensions programme becomes effective."

On December 19 it was announced that steel mill operations in the United States during the coming week were scheduled at 94.5 per cent. of rated capacity with production at 1,742.100 tons. This compares with 94.1 per cent. and 1,597,000 tons in the corresponding week of last year.

Catalogue Received

Patterns. To the best of our knowledge a six-page illustrated folder received from Harvey & Longstaffe, Limited, of Holt Town, Beswick, Manchester, 10, is the first piece of publicity we have ever received from a firm of patternmakers. It has been carried out in blue and white and is distinctly attractive. More extensive use might have been made of the neat little circular emblem appearing on one page. The folder is entitled "A Pattern for Engineers."

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FOUNDRY TRADE JOURNAL

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WITH WHICH IS INCORPORATED THE IRON AND STEEL TRADES JOURNAL

VOL. 87. No. 1739 DECEMBER 29, 1949

Registered at the G.P.O. as a Newspaper Offices: 49, Wellington Street, Strand, London, W.C.2

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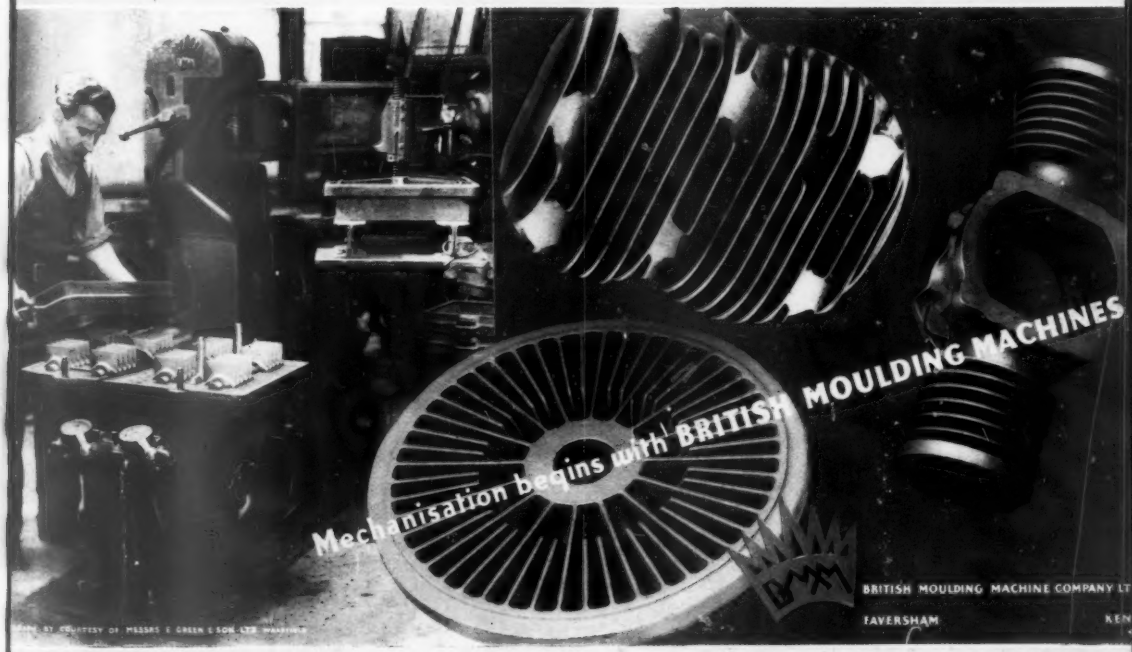

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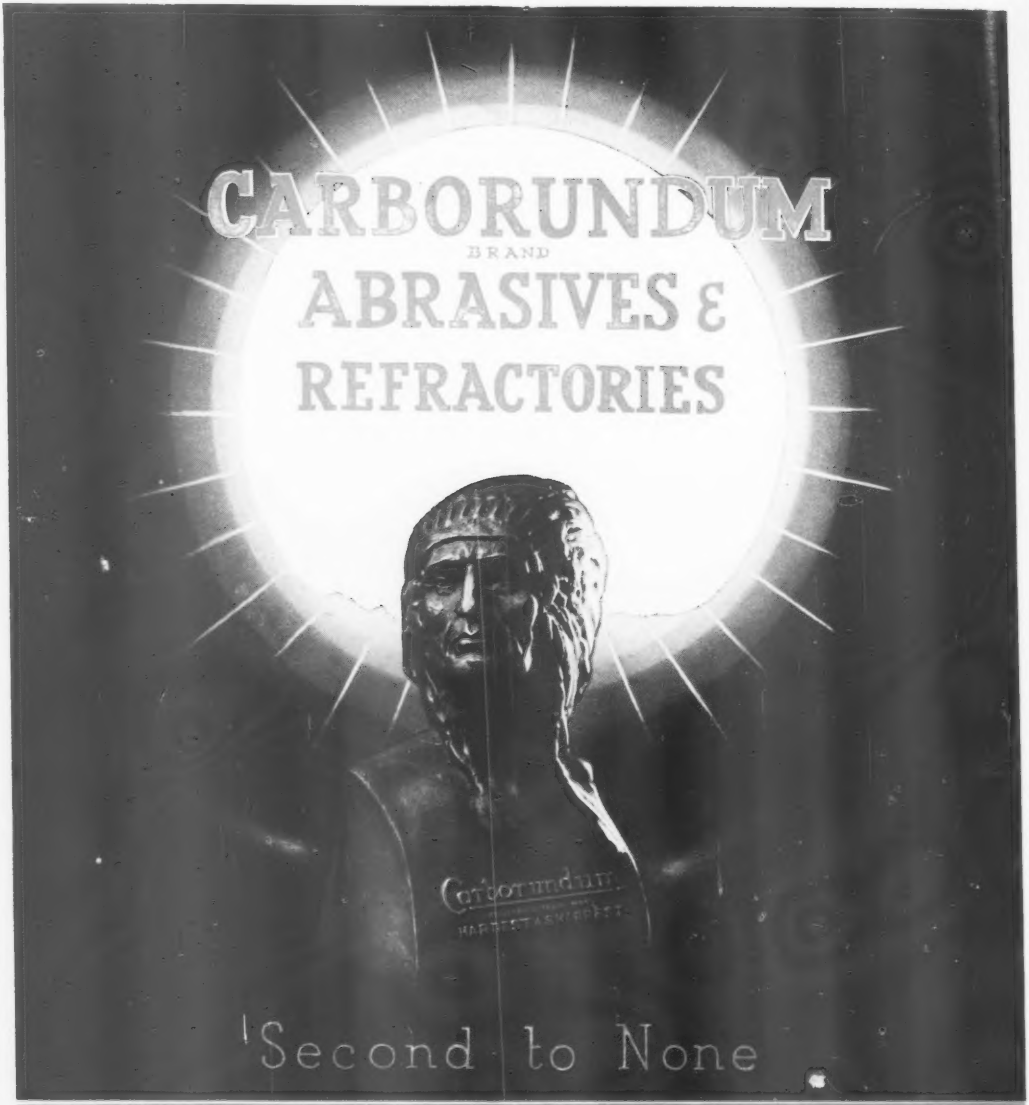

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